

A

PRACTICAL TREATISE

ON

CHIMNEYS;

WITH A FEW REMARKS ON

STOVES, THE CONSUMPTION OF SMOKE

AND COAL VENTILATION, &c.

PHILADELPHIA

BY

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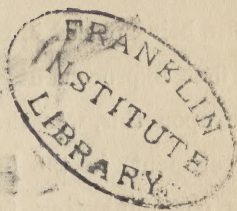
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PREFACE.

THE proper construction of flues, to answer the purposes for which they are intended, is but little studied and much less understood. I, therefore, presume that a short treatise from one who has had considerable, and I trust successful, experience may be acceptable to persons engaged in building, and advantageous to mankind generally: at least, in so far as what is set forth may be in accordance with the principles of the unerring laws of nature.

The method adopted by most savage nations for carrying off the smoke from their fires is, by a hole in the centre of the conical-formed roof of their huts,

the fire being placed immediately below the aperture. The first improvement which seems to have been made upon this, was the having a separate division, or apartment, in the building for the fire: with doors communicating from this "fire apartment" with the other parts of the house: by this means the heat was allowed to circulate, and one fire warmed the whole dwelling. In a book, published in 1776, it is said that flues of that sort were even then common in Scotland.

Chimneys are of comparatively recent use in England; for, in a book, published during the reign of Elizabeth, after remarks upon the modern improvements in living, is mentioned the convenience of chimneys. The author says, "Our forefathers had no chimneys, there was in each dwelling house only a place for a fire; and the smoke went out through a hole in the roof, but now there is scarcely a gentleman's house in England that has not, at least, one chimney in it."

There is also upon record that, during one of

Queen Elizabeth's Parliaments, a motion was made reciting that "Many dyers, brewers, smiths, and other artificers of London, had of late taken to the use of pit-coal for fires, instead of wood, which filled the air with vapour and smoke, extremely prejudicial to the health, especially of persons coming out of the country, and, therefore moving that a law be passed to prohibit the use of such fuel (at least during the Session of Parliament), by those artificers." But widely different are the days of Queen Victoria from those of her great predecessor! At a time like the present, when so many useful objects are accomplished by the use of coal: when, to the bountiful supply we have of it, are we indebted not only for heat and a beautiful light, but, as a great source of wealth to the country in her manufactures and commerce, it could no longer be a question whether the use of coal should be forbidden "during the Session of Parliament:" but rather in full concurrence with the words of Mr. Rusten to Dr. Franklin, that, "A smoky house and a scolding wife are

(said to be) two of the greatest ills in life." I would recommend that the "practical question" should be considered : viz. : Admitting coal to be almost amongst the necessities of life, what are the best means for carrying off the smoke emitted from it ; and what chimneys are best adapted for that purpose as well for ensuring a good system of ventilation ?

An early inclination to attend lectures upon scientific subjects (by which I obtained some slight knowledge of the laws of hydraulics and pneumatics) as well as *my own employment in life*, has brought me much in contact with these matters, especially since the year 1814, when I made the great improvements in the construction of kitchen ranges, which have stood the test of competition to the present day, and imitations of which have been set forth by many manufacturers as "newly invented self-acting kitchen ranges."

Shortly before the time of my invention, a cooking apparatus, or close cooking grate, was patented, which certainly was a cure for smoky chimneys : but

I contend that, although these grates may correct one evil, they as certainly bring with them another equally objectionable: for the chimney being almost closed, to cause it to act properly, the excessive unpleasant heat and smells from the heated iron, and particles of grease and other substances, as well as from the cooking generally, which would go up an open flue, cannot escape up a closed one, and hence a considerable portion of the house is rendered disagreeable, besides the kitchen being very unwholesome for want of ventilation: and, if a window be opened in the place where the cooking is performed, the more likely is the unpleasant smell to ascend the staircase, if there is one at hand. I am bold to assert that these close cooking stoves can only be used to advantage in large *detached* kitchens where the heat would not be oppressive, and, as they consume so very much fuel, where the amount of cooking would be adequate to the amount of the coal consumed.

These, and other objections to the close grates,

have led me constantly to recommend open fire-places for families in general.* I have fitted up many thousands of kitchens with my self-acting open range, and this has necessarily brought under my notice many so called "smoky chimneys," and imposed upon me the necessity of finding a remedy : but, as prevention is better than cure, I particularly recommend to the "building public" a due consideration as to the *construction* of flues.

The following little work makes no pretension to literary or scientific display : for, although originally intended for the law, and descended from ancestors whose sculptures and paintings adorn the Palaces of Prussia's Kings, Westminster Abbey, &c., I, myself, have been brought up as a practical smith, and have considered the subject before us in a mechanical point of view, treating of *practice* rather than *theory*,

* "When the cottager can afford to purchase a range, having an oven on one side and boiler on the other, the kind which we consider the most suitable is, that first made by Mr. Eckstein of London; figure 521."—London's "Encyclopædia of Cottage, Farm, and Villa Architecture."

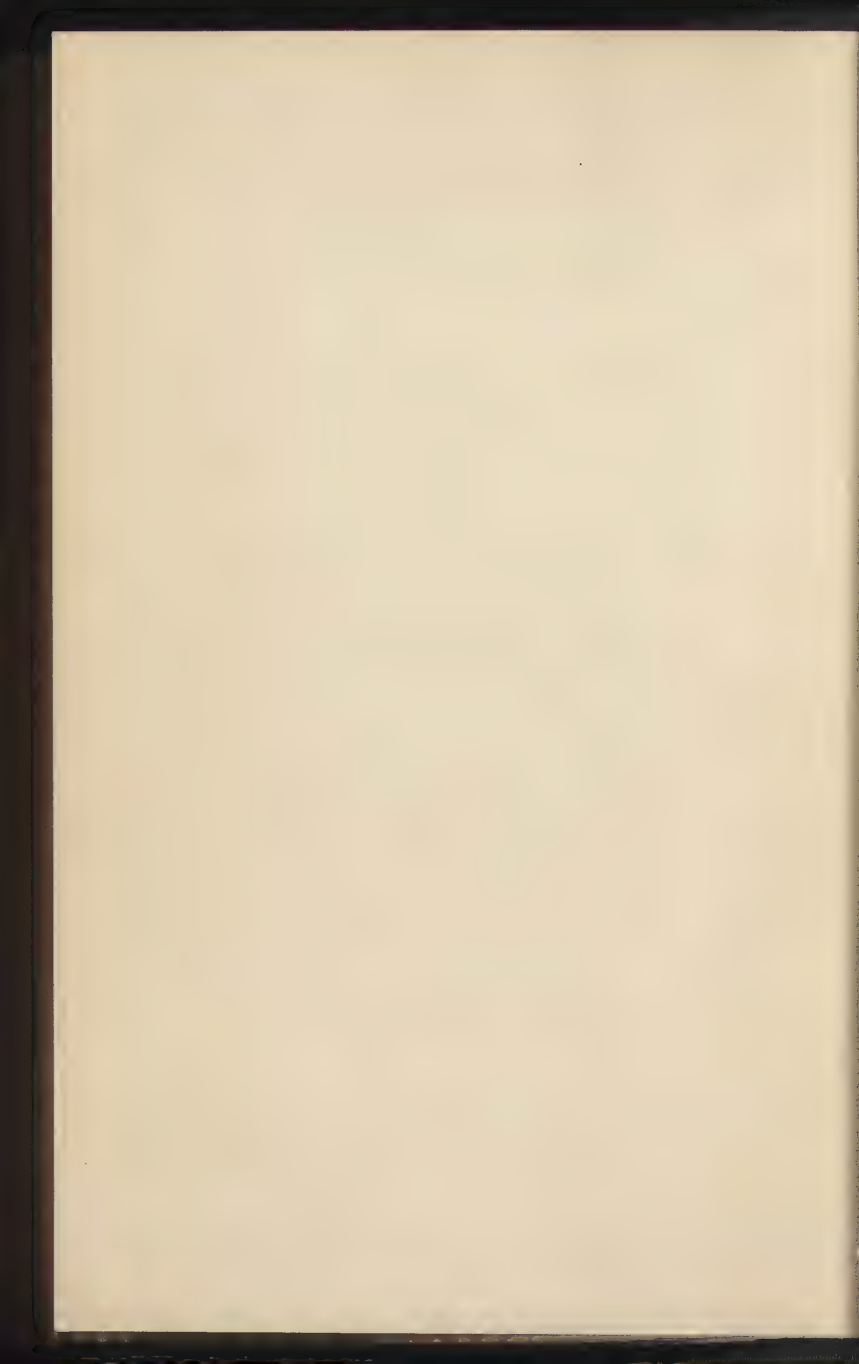
and giving the result of those *experiments* which, for thirty years, I have prosecuted with untiring energy.

The major part of these pages was written in the autumn of 1849 ; a severe illness and other circumstances caused me to lay aside my work, the *subject* of which had cost me so much labour, and which will, I hope, alone command a little attention, howsoever feebly it may be treated.

GEORGE FREDERICK ECKSTEIN.

16, Lloyd-square, Pentonville,

June 4th, 1852.



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INTRODUCTION.

FLUES, whether for the cottage or the mansion; whether for the kitchen or the dressing-room; whether for cooking, to be performed in the basement of the house, or in an out-building, or, as in many instances it is, in the upper part of the house: whether there be five stories above the kitchen for the smoke to ascend, or whether there be no story at all above the kitchen, the practice is, with few exceptions, to construct the flues of uniform dimensions, except in *height*, in which they differ according to their situation in the house, or according to the elevation of the house itself. If an engineer is employed to raise water, he constructs the pump according to the quantity required, or height it has to be carried. If in the case of sewers or drains they are usually constructed with reference to the quantity of water to be carried off: if an optician is required to supply a telescope, he provides it with glasses of a power

suitable to the purpose for which it is to be used ; but, if a chimney is to be built no consideration is given to the subject, and if perchance it carry off the smoke, all is well, and if it do not, it is called by the builder "a proper flue" because it is built in the usual way : though I cannot understand that a chimney is "*proper*" that does not perform its office, more than a sewer or pump that does not carry off or raise the necessary quantity of water.

In the "Architect and Building Operative" of May 24th, 1849, we find the following remark :—
"The architect seems to think, if he makes a vertical passage (or tortuous as the case may be) by which the smoke *may* ascend, *if it so pleases*, he has done his duty, and if the smoke will not pursue the road he has made for it, why, it is no business of his : the smoke doctor must be sent for ; and now mark the results," viz. : giving what the writer calls "an interesting picture," a sketch taken from H. R. H. the Duchess of Kent's town house in St. James's Park, with about two dozen curiously formed caps, or pipes, upon the chimney tops, he then continues : "and certainly this display is not an isolated specimen of the art of smoke-doctoring, for many such distinguish our metropolis, so that a Frenchman remarked to me some time ago, that 'London was not

only the most smoky place he ever beheld ; but, that we made the most of our smoke :’ ” and the writer goes on to say that the appearance of such a building “ would almost teach the intelligent observer a useful lesson. It is evident that the tubular group has been *arranged* (?) without any original plan, but by *the rule of find out.* ”

In a work quoted in the preface and published A.D. 1776, the following occurs. (I will give the passage although I think that too many of my readers may have *felt* the inconvenience occasioned by the little attention paid to this subject.) “ If it is necessary in other parts of the world to exclude smoke merely for the sake of personal gratification, it becomes doubly so in Great Britain, where pit coal is the most common sort of fuel, the smoke of which is not only disagreeable, but absolutely noxious as many well-known facts too fatally declare. To guard against these inconveniencies much ingenuity has been exerted, and many contrivances have been adopted for effectually carrying off the smoke from our dwelling houses : but, unfortunately these have been for the most part the inventions of men, who, being unacquainted with the physical causes of the ascent of vapour, were unable to distinguish with certainty those circumstances that were most effectually necessary

for promoting the emission of smoke, or that tended most powerfully to prevent its going off in a proper manner : hence their efforts have been chiefly directed to improper objects; and the inhabitants of this island feel to their cost, that in this age, when philosophy has lent its aid towards perfecting almost every other art, the builder of chimneys has been left to grope his way in the dark without an assistant; and, in almost every instance his attempts to improve upon the practice of his predecessors have been unsuccessful; so that the inhabitants of this country, with justice, complain that the inconveniences felt in new houses from this cause usually are more than sufficient to counterbalance all the elegancies that modern refinement has introduced into the dwellings of individuals." This was written nearly a century ago ! How truly does it represent the state of things under which we now suffer, and how astounding is it, when, during the last few years, the arts and sciences have made such rapid strides, and luxury and refinement have attained so high a pitch that *that* knowledge which should exclude a noxious vapour from our dwellings and do so much towards bringing health and cleanliness to our homes should be, in so great a degree disregarded !



A

PRACTICAL TREATISE,

ETC.

CHAPTER I.

On the Manner in which Modern Chimneys are usually built, and some of the Methods in Practice to correct those which do not effectually carry off the Smoke.

As all bodies are, by the attraction of the earth, drawn towards it, the velocity of their descent being regulated by the space through which they have to pass: and, as water exerts a force agreeable to its height, so the sooty particles emitted from coal (being heavier than air), would also be so drawn, unless acted upon by surrounding causes. As smoke from a camphine or other lamp, when improperly trimmed, will be seen to rise to the upper part of the room, and then to spread under the ceiling, so, when it becomes cool, will it fall on every part of the room.

In some cases, the smoke appears to go off entirely; in others, much soot falls in the apartment where the smoke is generated: hence arises the necessity to

inquire *why*? I have said that the sooty particles emitted from coal are heavier than air, and thus it is that they can only ascend when accompanied by warm or rarefied air, which is well known to be lighter than cold air; so that smoke does not show any disposition to go up a flue, unless that flue be warmer than the room where the fire is, and then only in proportion to the amount of heat created, and the area or length of the chimney.

Some chimneys appear to be always in what is termed a "drawing state" (even when there is not any fire, which is, in fact, only the surrounding atmosphere, from its superior weight, pressing to enter the chimney at the bottom, and so driving up before it the warm atmosphere it may there meet): this arises from some local cause, such as the chimney being in a stack, where there is, at least, one fire throughout the year, or from its being in a south aspect, exposed to the heat of the sun; but, should that flue become colder than the room (as flues in a north aspect frequently are), then the air will pass down the same, and produce what is usually termed a "downward draught;" and operators, thinking this the result of a defect in the form of the chimney, try all sorts of experiments to correct it, without perceiving the real cause; and, as air presses at any

angle with the same force, so it will press down a crooked tube with nearly the same velocity as down a straight one, and, therefore, a crooked tube at the top of a chimney cannot have much effect.

As water gives a pressure according to its altitude, so a flue has the power or capability of taking off smoke according to its height. A tall flue will take off more smoke than a shorter one of the same heat (which has the same supply of air); therefore, as in many instances, it is extremely inconvenient to make high chimneys, it is necessary to have recourse to art to produce a similar effect.

As a twenty-four inch cube of wood will, if immersed in water, support more weight than one of twelve inches, by displacing eight times as much water; and as a piece of board, twenty-four inches square, will support upon water four times as much as one twelve inches; or, as a balloon of large dimensions, filled with light gas, will carry up with it more weight than one of less bulk; or, as a pump with a large barrel will, when the bucket or plunger is removed, make a larger vacuum, or will allow more water to follow it, by the pressure of air upon the surface of the water in the well or tank, than a smaller one, so will a flue of large dimensions, when heated, be more powerful than a less one of the same

temperature (the case being analogous to the action of water in a pump, &c.), the air in the heated flue being of less specific gravity than that in the room, and being disposed to rise, is closely followed and acted upon by the more dense air in the room pressing forward towards the mouth of the flue. And as hydraulics, hydrostatics, &c., operate in conformity with the laws of nature, may it not be hoped that ere long, chimneys may be constructed with reference to those laws, upon pneumatic principles, and thus render it a *certainty* that chimneys so built may perform their proper office, rather than, as now, a matter of the greatest *uncertainty*?

But it is to be remembered, that many matters of science and utility have been neglected for years, or even lives, before the public have adopted them.

I attended Mr. Winsor's lectures upon gas nearly fifty years since. He then used it privately in his house, but even after this a few years elapsed before he could prevail upon the public to sanction or adopt gas for those street lights which have proved so valuable. The first lectures he gave in London were at the Lyceum Theatre, in the Strand (the advertisements to the public were headed "beautiful illuminations from smoke"), and afterwards at a house in Pall-mall, where he entreated the aristocracy, and

particularly the members of both Houses of Parliament, to visit, gratuitously, and witness the experiments he was making in the above useful production. Mr. Winsor was at considerable expense and trouble, before the present Chartered Gas Light and Coke Company was established, in 1812, and the subject fairly brought into operation.

If proof were wanting of the little attention paid to the *causes* of smoky chimneys, it would be only necessary to notice that whole stacks, each chimney coming from a different floor in the house, and consequently *differing* in length, have long pots, or metal tubes, of *equal lengths*, and often of the most ludicrous forms, put upon them, many of which cannot be cleansed of the soot, except from the top of the house, at considerable risk of damaging the slating, &c. Now it must be evident to any one who will think for a moment upon the subject, that a flue fifty feet long cannot want lengthening so much as one of ten feet; or, if a flue fifty feet long require five feet to be added to make it perfect, surely one of ten feet will require more; or, in other words, if five feet be a sufficient addition to a ten feet flue, surely one of fifty feet will not require any.

Chimneys are intended to carry off the smoke generated by any quantity of fuel the grate or fire-

place may contain ; therefore the flue should be constructed with reference to the opening of fire-place, or size of the grate to be placed therein.

If chimneys are properly constructed, and a sufficient quantity of air is admitted into the apartment to make up for the deficiency created by the supply of combustion, and for that which is continually rushing up the chimney, they must perform well.

The quantity of air required for a room must differ much, according to the quantity of fire in the grate, the size of the flue, and also the heat of the same ; as the higher the temperature of the air in a chimney, the more rapidly will it ascend, and, consequently, require a larger quantity from the room to make up the deficiency ; probably it may average from thirty to sixty cubic feet per minute, and this consumption, or loss of air, must be replaced by some means, as the same quantity must be admitted to the apartment.

CHAPTER II.

On some of the *Causes* of "Smoky Chimneys."

CAUSE 1. Chimneys, especially kitchen chimneys, frequently smoke from their being too small. Upon the principle, already set forth, that a pump or sewer must be constructed with reference to the work it has to perform, so a chimney will not act unless it be capable of containing a sufficient quantity of warm, or *light*, air to allow the smoke generated in the range or grate to be carried up by the pressure of the air from the room.

Cause 2. Is the chimney-pot being too small to allow the free passage of the smoke from a kitchen, or other large fire-place.

Cause 3. Chimneys frequently smoke from their being too short, as in attics; for, although the openings for the stoves, in that part of the house are usually small, which is an advantage, the flues have not power to contend against the dense air at the

top, and the various currents and eddies occasioned by the wind ; to guard against which, wind-guards (as they are called), chimney-caps and tubes are daily advertised, the intent of which being *said* to prevent the air from passing down the flue, and also to assist the ascent of the same.

Cause 4. A large opening of fire-place, that is to say, an opening disproportionately large to the size of the chimney. As water passes more slowly (which is perceptible) through the wide part of a river, or stream, than it does through the narrow, or under a bridge where the piers, &c., reduce the water-way, the same quantity of water having to pass, so kitchen chimneys, with large openings at bottom, are more disposed to smoke than those with narrow ones, as the air, in entering them, being dispersed over so large a space, the current is not sufficient to carry up the sooty particles with it, and allows much to fall in the room. The air will, however, pass more freely under that part of the chimney breast that is immediately beneath the upright shaft, and the range or grate should be so constructed for the fire part to be as nearly as possible at that point: *i. e.*, towards the right or left of the fire opening as the shaft may be. It is *not* said with reference to the front part of the grate being *forwarder* than the shaft.

Cause 5. Chimneys frequently smoke from being in a cold situation ; as in an external wall with only the thickness of half a brick between the flue and the cold, or damp atmosphere, which is very usual in detached houses. Also in low out-buildings where the chimney is carried up alone above the roof, and all sides exposed to the cold, or against a wall with three sides exposed.

Cause 6. In the case of a low chimney being near a high building ; where the air, passing over the high building, will drop like a waterfall upon the low chimney ; or, when blowing strong from the contrary point against the high building, will rebound and form an eddy upon the top of the low chimney, and thus impede the free ascent of the smoke from the same.

Cause 7. Is there being two, or more, fire-places to one flue ; which, unless very judiciously arranged, is nearly certain to cause smoke.

In the following "Causes" there is no absolute fault in the flues themselves.

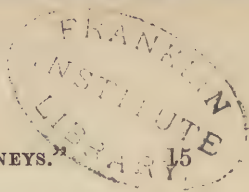
Cause 8. Is the want of a proper supply of air :—Many flues and stoves have been condemned as improperly constructed, especially in suites of rooms or offices, where there is but one door leading from the passage, or staircase, and which (when the joiner's

work is well executed) is the only admittance for air to support combustion, and to carry off the sooty particles emitted from the coal, the inner apartments depending for their supply upon well fitted windows, or doors, leading from the other rooms which have not any air to spare.

Cause 9. Large rooms having two fire-places, or drawing-rooms communicating by doors; if one flue is in a warmer stack than the other, or has a stronger fire kept in the fire-place, that one will take away the necessary supply of air from the other, or weaker one, and cause the smoke from it to descend into the room; and should there be no fire in the second grate, it will even draw the smoke down that chimney, from the surrounding chimney-tops, to feed that one fire and flue.

Cause 10. Many chimneys are called "dreadfully smoky" where the fires are seldom lighted, except in the evening, as is frequently the case in bed-chambers and dressing-rooms; for, at the time the fires are usually required, the house is warm and closely shut up, and there is so much air requisite to supply the different fires, lamps, candles, &c., in other parts of the house, that it is very common for the air to be rushing down the spare chimneys (to supply the others) sufficiently strong to blow out a candle, at the

CAUSES OF "SMOKY CHIMNEYS."



very time that the fire is required to be lighted, and the smoke is *expected* to ascend. Many years back, I constructed two stoves to warm the staircases at the Duke of St. Alban's, in Stratton-street. They were completed on Christmas Eve, the Duchess had a dinner party on that day, and the house was so warm from the number of fires and other causes, that the air came down the new flues with such force that I could not light the fires in the stoves, but the house was filled with smoke in the attempt, so much so, that if the Duke or Duchess had discovered it, they would, most likely, have ordered the removal of the stoves. I attended, with assistance, the following morning, provided with a quantity of light combustible matter to warm the flues, but it was not wanted, as the house had become cool during the night; and the fires were lighted without the least difficulty, or any smoke in the house. The best remedy that I know to counteract the downward action of air in a chimney arising from *this cause*, is, when a fire is required, to shut the door and open the window of the room, and to apply some lighted paper, or other light combustible matter, to the mouth of the chimney, so as to rarefy the air within it, and thereby cause an upward current before lighting the fire. The gentleman who introduced me to his Grace, and

who always afterwards employed me upon similar business, told me that I was indebted for the recommendation to the following conversation which he had overheard. He was one day paying some premiums upon policies, at the Sun Fire Office, when another person was giving notice that a descending flue had been erected at his house by me, and that he wished their surveyor to inspect the same as to its safety, in order that the necessary endorsement might be made upon the policy. The clerk replied, that as the flue had been constructed by Mr. Eckstein, he had no doubt as to its perfect safety.

Cause 11. Another annoyance from smoke is sometimes occasioned by the relative situations of the doors and windows in the room; by which the current of air from a door or window, having an outlet at another door or window, creates a sort of whirlwind, and drives the smoke out of the fire-place into the room before it reaches the chimney breast, as if bellows be used to a fire obliquely, the smoke and flame will be driven to the contrary side of the grate; the flue having no control over the smoke, which is driven away by a strong current before it reaches the chimney, as the air to supply the flue will pass immediately under the chimney breast, while the smoke is carried away by an under current into the room.

Cause 12. Another, and a very prevailing annoyance is, the smoke from an adjoining chimney, or from one in an adjoining stack passing down the flues that are entirely out of use, or at the time that there is not any fire in them.

Cause 13. It is not uncommon for chimneys to smoke at the sudden shutting of a door, especially in well-fitted rooms where there is an inadequate supply of air. When a door is opened inwards, it presses the air towards the chimney, and when suddenly shut, the air is drawn back from the chimney into the room, and this will generally produce a puff of smoke; but it must be quite obvious that this will take place in proportion as the room may be small or large; the less the size of the room the more will be the inconvenience felt, as the air admitted by the opening of the door, or displaced by the shutting of it, will bear a larger proportion to the quantity of air contained in the room.

Cause 14. Many chimneys smoke from not having been properly cored at the time of the building of the house; that is to say, before the house is occupied; and the same effect is produced by flues being inefficiently swept when in use.

CHAPTER III.

Practical Experiments in the building and correcting Descending Flues.

THE principle upon which smoke is carried off from the fire-grate, being that it is buoyed up by, or *ascends* in company with, heated or light air; it is evident that there must be some difficulty in obtaining the contrary effect, viz., in causing the heated air to *descend* a flue, and which it will only do when acted upon by a powerful ascending shaft, &c.

In the detail of experiments about to be given in this chapter, many of the difficulties of these flues will be exemplified. For entrance halls, and other parts of buildings, however, where heat is required, and no provision is made for a chimney or fire-place, it is frequently expedient to have recourse to a descending flue.

It is at all times an advantage to have a separate upright shaft for any stove, but it is much more re-

quisite for a descending one; for, although with a little judicious arrangement, such a flue can generally be carried into one already occupied by an open fire-grate, yet such a course is but the adding of another impediment to those flues which have already the descending and horizontal part to contend with.

Case I. Many years since I suggested what was then considered rather a novel mode of constructing two flues for open fire-grates, at the offices of an eminent merchant in the city of London. The talented architect, and the very eminent builder, appeared much to doubt the correctness of my premises, which were, for the flues to turn down behind the stoves a length of about six feet, then to pass horizontally about forty feet before they ascended, for which ascent there was only an unfavourable situation, viz., a cold and damp one, three sides of the shaft being exposed to the air (Cause 5). The prevailing opinion was, that this experiment would not answer for an open register stove, though it might for a close furnace. But there being no other plan suggested, that would not be detrimental to the architecture of the building (which was sixty feet wide by only eighteen feet high), a trial of my plan was allowed to be made, and with what success may be inferred from its having stood the test of eighteen

years. My object in having recourse to a descending flue, was to obviate the necessity of having a very tall chimney shaft near the front of a handsome, yet low building. This entailed upon me the difficulty of contending with the evils of a descending and horizontal flue, through which, as just said, the smoke would not pass, unless acted upon by a powerful upright shaft; to obtain which I directed that the ascending flues should be built fourteen inches square each in the clear, with four inches and a half of brickwork, and an outer case of brickwork of the same thickness, to be independent of the inner one (so as to leave a space for air between the brickwork of the flue and the outer case), and only united at certain points, in order to give stability to the work. Had the brickwork been a solid mass, it would have been a much readier conductor of heat and cold; the only use of the outer case of brickwork was to keep off the cold and damp atmosphere, and to prevent the heat escaping; as, the warmer the flue was kept, the lighter would be the air within the same, and hence the difference of gravity increased between the air in the flue and that in the room where the fire was; this would of course give additional power to the chimney, and thereby render the action more certain.

To protect the upright shaft from cold was very essential, as I again repeat, it not only had to draw the smoke down the descending part of the flue, but also along the horizontal part, which, instead of being any assistance, caused a slight impediment by friction, as well as the loss of heat, which heat would otherwise have assisted the upright shaft.

Case 2. Many years afterwards I was called upon to examine two flues from one room, at the house of a noble lord in Park-lane, built similar to those in the foregoing case, except that the upright shafts were only fourteen inches by nine, and the brickwork of the usual thickness. The builder was not willing to take down the upright shaft, and to reconstruct it upon the plan described (Case 1). I therefore, to produce a similar effect, suggested that an Arnott's stove should be placed near the bottom of the upright shaft, and an iron pipe from it carried immediately into each flue, so that a fire could be lighted, and one or both flues warmed by the fire in the Arnott's stove, before lighting the fires in the room. This stove might be kept in use the whole time that fire was in the grates, if necessary, and if not required after the flues were well heated, the air to be entirely shut off, as admission of air into a chimney, at any point but the fire-place, is an evil; but an Arnott's stove

requires so little air to support combustion, that the *small* quantity let into the shaft from it, at a very high temperature, would, under the present circumstances, do more good than evil, and I believe it had a tolerably good effect, though I do not know the ultimate result. If the flues had been protected from cold, and the register-stoves made with less opening at the front, they would have performed well, as the horizontal part was well built, but the two fires in one room rendered the case very intricate (Cause 7).

Case 3. On another occasion I was called in to examine the flue of a descending stove, which did not act, at a church in the city. I found it necessary to construct an entirely new flue: the horizontal part, which was about thirty feet, I directed to be of nine-inch earthen pipes, cased with tiles, to keep off the cold in the vault, and the upright shaft, which had three sides exposed to the air, to be formed of twelve inch pipe incased in brickwork four-and-a-half inches thick, to keep off the cold and wet. But there being rarely a fire more than once a week, the chimney was cold (Cause 5), and did not perform so powerfully as I wished; I therefore removed a stone base that was under the stove, by doing which I shortened the descending part of the flue about a sixth—viz., nine inches, and thereby considerably reduced the

work of the upright shaft. This proved quite satisfactory, but I am perfectly convinced that if the upright part of the flue had been of larger dimensions, and the brickwork four-and-a-half inch thick, with also an outer case of brickwork, as in the preceding instance, it would have been still more powerful.

Case 4. A descending flue was constructed in Canterbury, from a stove in a shop, to an old flue (the upper part of which stood alone exposed to the cold), about twenty feet distant from the stove, the horizontal part suspended to the ceiling under the shop-floor in the usual way—however, the smoke would not pass.

A very experienced and intelligent workman of mine, a smith, who had seen many similar flues, constructed under my direction, wrote to me upon the subject; but he was so much annoyed at the occurrence, that before my reply reached Canterbury he had started for London. He explained to me the difficulties that presented themselves, and the attempts he had made to overcome them, by endeavouring to warm the upright shaft at a soot-door near it in the horizontal flue, whereupon the flame, instead of taking a short route to pass up the ascending shaft, took the long route along the horizontal part of the

flue, and the smoke passed through the stove into the shop; but while he was persevering in his attempts to warm the flue (for, as I have already stated, there is no disposition in smoke to go up a flue unless that flue is warm), he found that when a certain door in the basement, near the place where he was applying the light combustible matter, was opened, the flame and smoke went the route he wished, and continued to do so until the door was again shut; therefore, by keeping the door open in the basement which communicated with the open air, he succeeded in warming the upright shaft, consequently the smoke from the descending stove in the shop passed off, and all appeared well. In a short space of time, however, the flue seemed to grow sluggish, and it ultimately ceased to act; so that it became my duty to turn my attention to it, and inquire into that, which, for a time, struck me as an extraordinary phenomenon. I had two points to consider; first, why the opening of a door communicating with air of more specific gravity than the air in the basement of the house, which had become a little lighter from the kitchen being contiguous, and other causes, should reverse the route of the flame, and smoke when generally it only assists the power of the flue? And, secondly; why, after the stove was in action, and the flue apparently

sufficient for its purpose, it should cease to perform? It occurred to me that the upper part of the chimney shaft being exposed to the cold, the heat that passed along the flue from the descending stove was not sufficient to keep the chimney warm at the top, and that the upper part of the flue, containing dense air, was just as much closed as if it had a plug of wood in it, or a covering over the top. The difference of gravity between the warm air in the lower part of the shaft and the air in the shop, did not give sufficient power to dislodge the air in the upper part, which, I think, accounted for the draught being reversed when a door was opened in the basement, by admitting air of a weight equal to that in the top of the flue, which admission of air, with the assistance of the flame the man was applying, appeared then to have the desired effect. Having arrived at this conclusion, the next difficulty was, how to keep the upright shaft warm at the least expense; whether to recommend a stove that would allow more heat to escape along the flue, and thereby consume more fuel; or, whether to rebuild the chimney-shaft with a case of brickwork around it, as we have seen under similar circumstances (Case 1). I proposed to the man that he should return to Canterbury, take off the chimney-pot, and place an iron pipe, of about

nine inches in diameter, and ten feet in length, down, and *within* the upright shaft ; the pipe having a flange at top to rest upon the brickwork, secured by cement, or otherwise, so that the heated air between the iron and the brickwork might not escape, by which means I expected that the real chimney, the iron-pipe, would be kept warm and thus assist, rather than impede, the passage of the flue. The more I considered the matter, the more I became convinced of the efficacy of this remedy, and was anxious for my man to start immediately to make the proposed alteration ; he begged hard not to be sent upon that business ; for, although he had, at the last journey, fixed a large cooking range with steamers, etc., in the same house, which had given very great satisfaction, he felt so annoyed at the failure of the descending stove, that he did not like to return ; he said that he would willingly have given a guinea out of his week's wages to have accomplished it when there, but, for fear of a second failure, he wished to be excused, and hoped that I would go, as I should then be on the spot to suggest other remedies, if necessary ; he also told me, that if I succeeded, the gentleman, who was much pleased with the " cooking apparatus," and had explained it with ecstasy to many of his neighbours, would be perfectly delighted.

ON DESCENDING FLUES.

I was reluctant to urge a useful and willing workman to do that which was evidently so repugnant to him, and, therefore, went myself to Canterbury, taking the pipes, etc., by the coach; on my arrival, I dispatched a messenger for the bricklayer, who built the horizontal flue, in order to ask him why it did not answer. He said the shaft wanted raising, and when he had taken off the chimney-pot he very much wished to place the pipe in the *usual* way, upon the top of the chimney to lengthen it, stating that, by removing the pot I had shortened the chimney instead of lengthening it; however, I pursued my own plan, had the pipe put *down* the flue and the flange secured; this answered my most sanguine expectations, so that, after receiving much eulogy and good hospitality, I returned to London highly gratified with my trip.

Case 5. In the foregoing cases the flues only descended so far as for them to be carried, or suspended, immediately beneath the floor of the apartment in which the stove was; but, in some instances, this arrangement would be detrimental to the use or to the appearance of the room below. To meet this difficulty, I have constructed a few flues to descend a whole story; for example, from a shop (the basement under which would have been rendered useless by

having a flue suspended from the ceiling), I have carried the flue down an upright column, then horizontally below the floor or pavement of the cellar, or kitchen beneath, until it reached the upright shaft in the building; but this will *not* answer unless the upright shaft is in a warm situation, and then the *descending* part of the flue should be much less than the upright, or ascending, part, as the disposition to rise in the descending part, from excessive heat, would be more than the ascending part could control. As all warm air, like the particles of water when heated, is inclined to rise, so the smoke and warm air of a descending stove could not go down a flue that was under the stove, unless acted upon by a superior power, such as the upright or ascending flue would be, by being larger and very much longer, though not of so high a temperature as the descending part. This principle is recognised by Hood in his excellent work on "Warming," page 148, where he says:—"Eckstein and Busby's Patent Circulator, or Rotatory Float, is an invention by which *centrifugal force* is made to overcome the *force of gravity* which, at first, appears to be singularly at variance with the general principles that have been laid down in this treatise; but, however its mode of action may at first appear to differ from the laws which have been ex-

plained, it is certain that, if they are derived from the laws of Nature, they must act equally, at all times, and under all circumstances; for the operation of the physical laws can never be suspended, though they may be occasionally neutralised, by a superior antagonist force.

“ In the case of two opposing forces, the resulting action is proportional to their difference of power; but when the antagonist force is removed, each will act according to its own peculiar laws.” Therefore, a flue descending several feet (which of necessity it must if carried down a whole story) would, according to the laws of Nature, when heated, have, in the descending part, a strong ascending power, which could only be reversed by a strong antagonistic force in the upright, or ascending, part of the flue.

I have frequently seen operators build flues, and attempt to correct others upon principles perfectly at variance with the physical laws, even as much so, as the putting one horse behind a carriage to assist the shaft-horse that was working the contrary way, and then express their surprise that the flue did not perform. I corrected a flue within the last few days, in Tottenham-court-road, where I perceived that three distinct alterations had been lately made, all opposed to the right principle, and when the operator had got

so far without any good result, he very modestly requested permission to make a new window opposite the fire-place, to force the smoke up, though the kitchen was already lighted by a good skylight, having three large openings for air. As soon as I removed the three impediments that had just been added, and made one alteration in the right direction, the flue performed well.

Case 6. I was, within the last few months, applied to by a gentleman at Balham-hill, who had seen the descending flue I constructed at the "Merchant's office" in the city. He wished me to supply and fix a descending stove in a detached billiard-room that had just been built *without any flue* at a considerable distance from the house. The architect and builder depended upon having a descending stove fixed with an iron pipe to convey the smoke to, and up the back front of the house; therefore, many pounds might have been spent in vain, if an operator had been applied to who did not think, upon what principle the smoke was to take such a route, but he would have found to his dismay (and loss to some one), that it would not, the flue would have been so cold (Cause 5). Therefore, I recommended, and fixed a stove in the room, with an ascending pipe. It was a curious coincidence that at the office where

this gentleman heard of me, I had suggested descending flues, in opposition to ascending ones that had been already commenced, and to him who wanted a descending stove, I recommended an ascending one.

Case 7. I have said that, to descending flues especially, it is an advantage to have a separate upright shaft; and yet, that with care, and by a little judicious arrangement, they may generally be safely taken into another flue already in use, which I have accomplished in very many instances. For this purpose it is necessary to carry up a flue by the side of the stove in use from the horizontal part of the descending flue (there is generally room between the angle of the fire-place and the bevelled cheek of the register-stove); the flue thus carried up to be as high and as large as it can conveniently be, without reference to the shape, that it may enter the flue common to both fires as high above the *open* stove as possible. A well-fitted register-door should be applied to the top of the open stove, and only allowed to be raised when a fire is in the grate, just enough for the escape of the smoke, the heat from which fire will so much heighten the temperature in the flue common to both fires, as nearly to counterbalance the evil of the register being open; and when there is no fire required in the open stove, the register-door must

be kept shut, to prevent the entrance of cold air (Cause 7). This is assuming that the open fire-grate is upon the same floor, or the floor above, where the descending stove is required; but if the open fire-grate is upon a floor lower than where the descending stove is placed, the flue from it must not immediately enter the common shaft, but must have a distinct upright shaft of some few feet. This occurred at the King's College, where I corrected several flues, one of which was upon what is called the ground floor, and taken into a chimney belonging to the basement, having a large open fire-place, the grate of which I exchanged for a register-stove with a well-fitted door, to be used only as above described. I also had the chimney opened where the flue from the parlour-floor entered, and widened sufficiently to admit of its being divided into two flues, which was readily done by building a lyth. I thus obtained a separate flue, from the stove upon the ground-floor, of about eight feet; and they both performed well. The back of the chimney, at the part opened, was adjoining a common staircase with stone steps, which gave facilities to the operations; but, in cases such as a number of flues in one stack, or of the flue coming from a large kitchen fire-place for cooking, this arrangement would not always be practicable.

CHAPTER IV.

Practical Experiments in the Building of Ascending Flues.

I WILL now instance some ascending flues in which difficulties in construction have presented themselves, and which, although less intricate than descending flues, no less require a due regard as to their proportions, and to the principles upon which they must be constructed.

Case 8. A gentleman (for whom I had previously corrected a kitchen flue at the house of one of his tenants in Chelsea, and also done much other business) was about to build a mansion near Hyde Park, and he asked me, if I thought it likely that the kitchen chimney would smoke; I said, "certainly not, if it were properly constructed." He very naturally replied, how should he know if it were *properly constructed*, and added that, would I direct

the building by being paid for so doing. This I undertook to do, and accordingly communicated with the architect who had kindly recommended me, advising that the flue should be eighteen inches by fourteen, also that a small air flue for the purpose of ventilation should be carried up close to the kitchen chimney, and which could readily be done as it was an entirely upright shaft.

Case 9. I was subsequently requested to construct a flue for a kitchen, under the garden of a house in the north-east corner of Cavendish-square, and from its peculiar situation it was necessary that the flue should turn off at a right angle, immediately above the fly of the smoke-jack, and continue horizontally, about twenty-five feet, to the back-front of the house, where it turned up at another right angle. The builder, who was an ingenious practical man, was fearful that such a flue would not perform properly, but I assured him that, if the upright shaft were carried up eighteen inches by fourteen to the top of the mansion, the power would be so great (being assisted by a continual large fire in the range, which would keep the shaft warm) that it must certainly answer well.

Case 10. In the two foregoing cases I have adopted large flues with success, but so little do some archi-

itects think the size of any importance, and so much do they seem impressed with the idea that since the sweeping of chimneys is performed by a machine, a passage of any dimensions will answer for the smoke to pass through, that I have known many talented architects to direct flues for general purposes to be built nine inches square !

At a vicarage-house in Hampshire, where I was consulted upon the construction of the flues, earthen pipes nine inches in diameter for a chamber flue in an *upper floor*, and twelve inches in diameter for the kitchen, where the opening for the range was to be five feet (Cause 4) were actually provided (Cause 1). The building being only two stories high, and one side of the stack of chimneys exposed to the cold (Cause 5), not only would the above-sized flue have been totally inadequate to carry off the smoke from the kitchen fire, but quite insufficient to cause the jack to perform ; I, therefore, directed the flues to be built fourteen inches square for the chamber (which being very short, required to be of large capacity), and eighteen inches by fourteen, for the kitchen chimney. I also provided for the ventilation of the kitchen by constructing an air flue, immediately under the ceiling, fourteen inches by four and a half, close to the flue from the range, that it might be

always warm to ensure an upward current; but, as the ventilating flue would take much air from the kitchen (Cause 8), I procured a good supply of fresh air through the ash grate in the hearth, by an air drain communicating with the external atmosphere, which was also very useful for the range flue, and for the supply of combustion, without having recourse to opening a door or window.

CHAPTER V.

Practical Experiments in the Correction of Ascending Flues.

I WILL now proceed to the correction of ascending flues, and I think that the illustrations which I propose to give will exemplify the inconvenience, trouble and expense, occasioned by the *misconstruction* of flues, and prove that, were due regard paid to the subject, all these disagreeables might be avoided.

Many chimneys, as I have before said, smoke in consequence of the chimney pots being too small (Cause 2). When the opening of the fire-place is large (Cause 4), the air enters over so large a space, that unless the smoke can escape *freely* at the top, it will escape at the bottom.

It sometimes happens, particularly in cottages, that the chimney pots are ornamental and small; and to alter them would very much damage the architecture of the building. I have frequently been able to avail

myself of other outlets for the smoke by cutting into adjoining flues, below the chimney pots, which will usually answer as well as enlarging the flues themselves.

Case 11. A case of this kind occurred at a handsome cottage upon Bushy Heath, where many attempts had been made to correct the kitchen chimney. I made an opening just below the pot into an adjoining flue, which was used for a *close* stove in the Hall, and therefore, could well afford to have an opening made into it without injury. (For it must be observed, that any hole in a flue is a drawback to the one into which the hole is made, whether it be to receive another flue or not; but, if warm air is admitted it will not be so detrimental as cold. And that this may the more agree with what is stated in Case 2, I would remind the reader that, in that instance, an Arnott's stove was used, the necessary supply of air to which is so very small, that it may be admitted through an opening of half-an-inch, and consequently, very *little* air entered the flue, and that in a high state of rarefaction. Any draught behind a stove to take off the dust from the fire-place is an evil, it letting cold air into the chimney, and should not be made unless it is a powerful flue and can afford such a drawback.)

By making the opening, just described, into the



adjoining flue, I obtained the advantage of two chimney pots for the one kitchen flue, which was as good as *one* of larger dimensions, without damaging the architecture of the house, and produced an excellent result; so much so, that the gentleman paid me my fee *instantly*, saying, he had one favor to ask, which was, the *cause* why the chimney originally smoked; for though he had watched the progress of the works, which only occupied two hours, he could not comprehend upon what principle I had been proceeding. He was a very scientific man, and an amateur turner.

Case 12. At a mansion, near Basingstoke, in Hampshire, the kitchen chimney had been a decided smoker for many years. There was a large tree close by, and the branches hung over the chimney top; it was said by the cook and other persons, that it would never be any better until the tree was removed. I perceived that there were other flues, from coppers and from a hot plate, which communicated with the kitchen chimney, and that the pot upon the top (Cause 2) was too small to allow the smoke to pass off from all of them when in use, and when out of use, the small flues being without dampers, the cold air passed up them to the detriment of the kitchen chimney (Cause 7).

With much difficulty I obtained a bricklayer, who removed the chimney pot and replaced it by one of larger dimensions ; and as I was compelled to leave by coach for London, I left instructions with the bricklayer to fix dampers in the small flues leading into the kitchen chimney, to keep out, as much as possible, the cold air.

Several weeks afterwards, when in that part of the country, I called at the house, and found that the chimney was performing well. I inquired why the dampers had not been fixed as I directed ; the cook replied, that the chimney answered so well after I left the house, she would not have any more done. It was a perfect cure, *though I had not removed the tree*. In fact I never knew “a tree” to cause a chimney to smoke. I presume that the air passes through the interstices of the trees, and so has not the effect of air passing over a high building, and falling like water upon lower objects (Cause 6). I believe fishermen and others, living upon the sea coast, frequently put a gooseberry bush in the top of the flue of their hut, or place a basket upon the same, for the purpose of breaking off the currents of air.

Case 13. The flues at the rectory-house, adjoining a church, on Holborn-hill, were supposed by some to be very imperfect, the different occupants having

been, for many years, much annoyed with smoke. The prevailing opinion, however, was, that the tower of the church was the principal cause of the evil. The kitchen flue was continually discharging part of the smoke into the kitchen; and when fires were lighted in the principal rooms, the smoke from them frequently descended the bed-chamber flues, and filled the rooms (Cause 12). An operator, some few years previous, promised, that if he were allowed to fix a new range in the kitchen, he would correct the flue of the same. He placed the kitchen-range about nine inches back from the front of the jambs, which was very inconvenient for cooking, as well as very unsightly. The smoke-jack was removed from the chimney to the cellar, where it lay till the early part of the year 1850, the chimney smoking as before: the house was then under repair, and the architect (the kindness of whom, and also of different branches of his family, I have experienced for more than forty years) allowed me to do what I thought would be requisite to correct the flues. I suggested to the gentleman about to reside in the house the propriety of restoring the smoke-jack to its former useful and proper place in the chimney, to which he consented, provided that by so doing I did not make the chimney smoke worse than before.

Upon examining the flue, I found it to be extremely well proportioned, but having a pot too small (Cause 2).

With the exception of being near the church tower (Cause 6), which did not give me any concern, the chimney was in a good situation,—it being in a large stack, nearly in the middle of the house; hence warm by its position, as well as by the number of fires that would be in winter lighted in the same stack. I then directed that the kitchen range, which had been taken out for repairs, should be set at what I considered the best position for use and appearance; namely, about four inches from the face of the chimney jambs. I always direct to have kitchen ranges so placed, if the fire-places are deep enough to admit it, and this for three reasons: *first*, it gives the best appearance; *secondly*, it makes a convenient place for the fire-irons to stand; and *thirdly*, it may prevent a remark, which is commonly made, if the grate is more toward the face of the jambs, and there is any disposition to smoke, “that it is what might be expected from a grate set so forward,” which remark I have often heard from very talented men who, it seems to me, do not much consider the causes why chimneys discharge part of the smoke into the room where the smoke is generated; and as all I can

say will not convince them that the placing of the range forward is not the cause of smoke, it is best to avoid the occasion for remark; and when, for the want of depth in the fire-place, I cannot place the stove so as to show a margin of three or four inches, I recommend the stone jambs and mantel to be blocked out with brickwork, in order to form a margin before the front of the grate, for appearance *only*, as it does not at all alter the position of the fire regards its being more or less under the flue.

I then directed that the "jack" should be replaced in the chimney, but the setting of the range forward, and the refixing the jack, would be no assistance to the chimney; it was more likely that the friction of the air and smoke against the "fly," would be a very slight impediment, to counteract which, and to improve the chimney generally, I exchanged the chimney pot for one of larger dimensions.

To prevent the smoke descending into the upper chambers, I put longer chimney-pots upon the tops of the dining-room and drawing-room flues, so as to carry the smoke off *above the tops* of the chamber flues, that if air came down those chimneys, when out of use, it might not bring the smoke with it; and I believe the excellent man, who at present occupies the house, is as free from the annoyance of smoke

as any of his neighbours, though the church tower still remains !

Case 14. A wine merchant who, in addition to his city house, had a depôt and office at the west-end, proposed to give me a very liberal amount, if I would make a perfect cure of his office chimney, which was in Park-lane, near Mount-street. The flue (Cause 3) was only the height of the garden-wall, about ten feet, and the persons occupying the mansions which overlooked the low-building, would not allow a tall chimney to be constructed, nor a long chimney pot to be placed there ; which prohibition, I feared, would render it impossible that I should thoroughly succeed, as I considered it absolutely essential to raise the flue. However, I told the gentleman that, if he were willing to go to a few pounds' expense, I would much *improve* it. With his permission I caused a register stove to be fixed, with fire lumps and a very small opening above the fire ; so that the air which in passing it would become heated to a high temperature, might rush through the contracted aperture with a velocity that would enable it to resist a pressure upon the top from the air coming over, or blowing against the high buildings (Cause 6). Much to my surprise, I had the satisfaction of hearing that this answered perfectly.

Case 15. Some years afterwards, a builder in extensive practice applied to me to correct two flues which were just built in the premises adjoining those named in Case 14: one from a sitting-room, the other from a kitchen, and only as high as the garden-wall, like that just described, except that they were carried several feet horizontally, in order that the tops of the flues might be further from the mansions. I employed the same sort of stove for the sitting-room as for the office in the previous case. In the kitchen, without removing the range, I reduced the opening above the same, which was three feet wide, to two feet three, by building four inches and a half of brickwork upon each hob; I also reduced the opening from back to front; and the chimney was longer than that in the sitting-room, as the ground had been excavated for the kitchen. This, as well as the other, succeeded better than I could have expected; indeed, the tenant, who before the alterations had declared the rooms were not habitable, was perfectly satisfied.

Case 16. I supplied a kitchen range, with a steam apparatus, at a house at Enfield, upon the express condition that the chimney should not smoke after the range was fixed. In order to see what alteration the chimney required, I attended at the house upon the day appointed for the setting of

the range: I was just in time to prevent its being set about nine inches back from the face of the jambs. A man that had been with me thirty years was there to assist, and the only excuse he could make for allowing the bricklayer to depart so far from my general orders was, that the old range was so placed, and that he was informed that the chimney was a desperate smoker, and was known to have been so for more than thirty years, by the present occupant who had caused the chimney to be taken down and rebuilt twenty years since, without any good effect. I did not give my man any instructions, before leaving London, as to the position of the kitchen-range, because, from his long experience, he ought not to have required any; but bricklayers, who have fixed ranges for me many years, are continually asking me where they shall place them, and how much from the face of the jambs, and think they would be much less likely to smoke if they were placed further back (Case 13). But to return to this desperately smoky chimney, I found it was an exceedingly good flue of fourteen inches square, with two floors above the kitchen and only one side exposed to the cold, but the chimney-pot was too small (Cause 2), having an area of only about eighty-five square inches: I exchanged it for one containing

about a hundred and seventy square inches, and both smoke-jack and the chimney performed admirably. I have also corrected many flues for the same family, and some very difficult cases for many of their friends.

I never found a chimney to smoke from the grate being set forward; though it is generally the first thing noticed and complained of. And with regard to having the chimney-breast thin (which is an idea so deeply rooted in the minds of most persons, that I have known some very good architects continually to recommend chimney bars which are bevelled off inside for that purpose). I would be quite as willing to undertake to remedy, and expect as much success in correcting a flue that was built upon a cradle bar, and the breast of the chimney fourteen inches thick, as I would a flue built upon a bevelled bar, perhaps starting at one inch: and that, from a firm conviction that my theory is founded upon a right principle.

When a kitchen chimney smokes from the fireplace being too high, the usual means for its correction is a blower to hang down outside the stone mantel (the smoke, however, often makes its way behind the blower, and blacks the face of the stonework), or an iron plate placed inside the jambs,

which will save the mantelpiece from becoming black; and not only does this blower reduce the opening of the fire-place, but presents a "thin edge," so much desired! Instead of this, I prefer to use a wide iron bar with four-inch brickwork, and, in some cases, nine-inch, built inside the stone jambs, which reduces the opening from back to front, as well as in height; and as the same quantity of air will pass the reduced opening, to make good the escape at the top of the chimney, as did when the opening was larger, it will sharpen the draught, as it is called, and the air will then come more in contact with the heat of the fire, by passing immediately over the fire-place, thereby lessening its specific gravity and increasing the velocity. And if the brickwork at the back of the fire-place, above the kitchen range, is built forward, except that part immediately behind the fire, it will cause the air to pass with more rapidity at the required point, and carry with it the smoke generated by the fire.

Case 17. The following is to prove that the thickness of the chimney-breast is not the cause of smoke. I was applied to, a few years back, to allow a workman to assist in detaching the pipes from a kitchen-range, at the house of an eminent civil engineer, for the purpose of resetting the range farther back in

the fire-place. I asked the bricklayer why he wished to remove the range which had been fixed many years, and had always performed well. He replied it was "to cure the smoking." He had already commenced to take down the brickwork. I asked to see the principal, but he being from home, I saw his wife and said to her, that I had been upon terms of friendship with her husband nearly forty years, and therefore hoped, *although he was not there to give the order*, to be allowed to correct the chimney, which I could do in one hour without the trouble and dirt of removing the grate. I was permitted to stop the workmen from taking down any more brickwork, and to cause that part already removed to be replaced. By the time this was done the master-builder had arrived (one of the workmen having very adroitly stepped out and given him notice what was going forward), who, upon seeing me, said, I was "not aware of the thickness of the chimney-breast." It was a very deep fire-place, and certainly the chimney-breast very thick, being a very old building in Chancery Lane. I told the builder that thick as it was, he was at full liberty to add fourteen inches to the thickness inside, if he pleased, and I would then readily correct the flue without removing the grate as there would, *even then*, be sufficient room for the

smoke to pass. The fact was, that the roof of the house and the chimneys had been raised to improve the attic story; and, though raising the stack of chimneys, had given extra power to the kitchen flue, the effect had been reduced by the placing of a small chimney-pot upon the top (Cause 2), which I immediately exchanged for a large one, and the smoke was allowed to pass off freely. The builder was a man of considerable experience who, after seeing the above result, said he much wished to consult me about correcting another flue: unfortunately, he died soon after, and I never attended to the case he mentioned.

That smoke will make its way, with a current of air, to the opening above the stove, whether the chimney-breast be thin or thick, may daily be seen by the common fire-grate; as, when smoke is issuing from a coal burning in the front of the fire, it will bend its route over the upper bar of the grate, and pass on to the opening at the top of the same, with the other smoke and air; it will not rise perpendicularly, as those would imagine who recommend the fire-bars to be kept immediately under the flue and within the chimney-breast, but it will keep clear, and generally at a considerable distance from the front of the register stove, or chimney piece, as the

case may be, and only strike against it when the flue is otherwise imperfect, or a supply of air is required.

The same effect may be strikingly seen by the issuing of steam from the spout of a tea-kettle on the fire; or, more properly speaking, what has been steam, steam being colourless it can only be *seen* after condensation has commenced, and this condensed steam, or distilled water, is the only water we can get that is perfectly pure and clear of other matter, and always of the same weight: the former property giving it great value in medicine; and the latter, enabling the scientific man, in any part of the world, if he possesses a correct measure, to form weights precisely like our standard weights. The nearest approach to distilled water is rain, which is chiefly produced from a sort of distillation by the action of heat upon the earth and waters.

If any of my readers doubt the correctness of my assertion that steam is colourless, and have not time or disposition to attend lectures, or much to study the subject, they may readily convince themselves by making water boil in an oil-flask, or any other transparent vessel, partly filled: they will not see any steam upon the *surface* of the water, but will perceive it only when it comes in contact with the air, above the neck of the vessel, and is thereby con-

densed: or with less trouble, by observing the exhalations from animals. A man cannot perceive the the vapour or breath, as it is called, from his own mouth, upon a warm day, yet he can do so upon a cold one; though in the former case his body is at least equally warm, and I presume exhaling as much. Also the post-horse, after having run a long stage upon a sultry day, must be equally heated and exhale as much, though *not so visibly*, as upon a cold day, for in a warm atmosphere the aqueous vapour, or steam, will condense more slowly.

Case 18. At a house situate in a Park at Enfield, the kitchen was upon the ground-floor, having but one storey above it; the flue was therefore short, and only of the usual size, fourteen inches by nine, and notwithstanding that it was in a warm situation, being in an internal wall, it had smoked from the time the house was built, namely, a period of twenty-eight years, and many attempts to cure the same had proved fruitless. Want of power (Cause 1) being the fault in this flue, I set about enlarging it, which I did by directing the chimney shaft to be pulled down as low as the gutter of the roof, and to be rebuilt from thence upwards at twice its original size, till near the top (about seven feet above the roof) I reduced it to receive the "cap," which was

five feet high and fourteen inches square. These means, the doubling the size of a part of the chimney shaft, and the adding the high cap, were equal to the elongating of the chimney ten feet. I would have preferred to enlarge the flue its whole length, which would have made the long cap unnecessary, but this I could not do without damaging the other rooms.

I wish it to be understood that, though the general opinion is that flues should be constructed of equal size from the fire-place to the top, I contend that enlarging them at any point (except the opening for the fire-place) is not an impediment to the smoke passing, but will give additional power.

Case 19. I will follow this by another similar instance. A kitchen flue at Littleton, in Middlesex, having also to receive the smoke from a hot-plate and oven, had, for thirty years, been found insufficient to carry it off. The insufficiency was occasioned by the flue being too small (Cause 1), and also being situate in an external wall; this made it cold (Cause 5), but gave me the opportunity of enlarging it the more readily, which I did by cutting open the chimney several feet in its smallest part, and widening the same.

Case 20. On another occasion I was required to

correct a chimney, at a farm near Bromley, in Kent. It was in a detached room; and there being no building over it, the flue was short (Cause 3), and it had only been built nine inches square. As the flue was exposed to the farm-yard, I ordered it to be cut open all the way up, and enlarged to fourteen inches by nine; and by reducing the opening of the fire-place I obtained the desired effect.

Case 21. At a neat cottage, near Reigate, the kitchen-flue was short and the chimney-pot rather small; it had, however, the advantage of a warm situation, having a room at the back of the same; but this took from me all means of enlarging it; and I could not remove the chimney-pot without damaging the architecture of the cottage.

In addition to the chimney being very feeble, the fire part of the kitchen range was more under the gathering wing than it was under the upright shaft (read Cause 4), consequently the air passed up the flue without coming much in contact with the fire, and the smoke was not well carried up. I directed a small wing to be made upon the opposite side to where the fire part of the range was, that the air should necessarily pass over the fire and, as the opening of the fire-place was higher than needful, I directed the breast of the chimney to be lowered,

which was done by building nine-inch work upon a cradle bar. The reason I directed nine-inch work was, that by reducing the opening from back to front, the air would pass through the reduced opening with more rapidity (as does water through the narrow part of a river), and, as it would have to travel more to the back of the fire-place, it would receive greater heat from the fire. This improved the action of the chimney, though most of the persons who saw it would not believe it right in principle, so generally does a thin chimney breast appear the great desideratum.

Upon one occasion, when I went purposely to see how the flue performed, the cook, seeing me at a distance, very carefully took off part of the fire and supplied a large portion of fresh coal to endeavour to cause smoke to come into the kitchen, but it did not succeed. I watched the progress for several hours, and the lady said the cook put the quantity of fresh coal upon the fire, as I came through the grounds, to give it a "fair trial;" but I must confess that I considered it rather an *unfair* trial. I call a "fair trial" of a chimney to use the fire and coal as they are wanted and usually used, especially in such a case where I could not promise to cure the chimney without rebuilding the same.

CHAPTER VI.

Description of Hiort's Patent Bricks—Experiments in the use of them—and also on other Circular Flues.

I HAVE attended, with much pleasure, many lectures delivered by the late Dr. Birkbeck, whose great talent and goodness of heart were, for many years, devoted to the instruction and improvement of his fellow men; and, whether the subject were Mechanics, Hydraulics, Pneumatics, Chemistry, Electricity, Acoustics, Optics, Anatomy, the Muscular Powers, the Digestive Organs, the Faculties, the Bony Systems of man and the lower animals, his general scientific knowledge, command of language and anecdote, always rendered his discourse instructive and pleasing.

Upon one occasion, a short time after a gentleman had given an excellent lecture at the "Mechanics' Institution," upon the construction of arches (and when I heard a man remark to his son, that they

now knew *why* a certain arch gave way, before they only knew that it did fall), the doctor delivered a lecture upon the building of flues, apparently, to me, for the purpose of introducing Mr. Hiort's "Patent Bricks" to the public.

These bricks being made in the form of a quadrant, four was a set for one course, and formed a circular flue of ten inches in diameter, which was all that could be made in a two-brick wall; and when the walls were thicker, and a flue of twelve or fourteen inches in diameter was to be built, he used, in addition, what he calls "club bricks," for that purpose. Some of the sets of four were so made that, when together, they were thinner on one side of the circle than on the other, resembling a wedge, and were thus very convenient for directing the flue out of the upright (without cutting the bricks) to any required inclination, by placing the thick parts upon each other, or partially so, as might be necessary.

The doctor explained what he considered to be the advantages of the patent bricks: first, the flue being circular; which seemed to him the best form: secondly, the inside of the bricks being glazed, there would be less friction for the air in its upward passage; and thirdly, there would be less adhesion

for the soot; and he added, that if a flue were built of such bricks and of a moderate length, it would perform well. He ridiculed the practice of builders in only having resort to the lengthening of flues, if they did not act, and said they would carry them as high as the Tower of Babel if they could conveniently erect a scaffold; but he did not say what was to be done in lieu of raising them, if they were disposed to smoke; I therefore was not fortunate in gaining information as to the *cause* why chimneys do not perform uniformly well.

I did not then see anything wrong in these patent bricks; and I was of opinion that the "circular" form was exempt from the following disadvantages: for, believing that smoke ascends in a chimney as other fluids descend a pipe, spirally, it would appear that the angles, as well as bends, in a flue must cause *friction*;—and so also must the widening of flues in *part* (to obtain power, as in Cases 18 and 19), but so very slight are these impediments, that I have never found any perceptible effect from them in the ascent of smoke; and I do not contend, as many do, for smooth surfaces and well rounded "bends;" considering that the friction of air in a flue, unlike friction in machinery, is very unimportant; but I attend to defects of greater magnitude,

and, as is done in machinery, I obtain sufficient power to overcome friction. The speedy disuse however of the above bricks proved that they did not answer; later experience has taught me that the fault consisted in their forming a flue too small, the 10-inch flue being usually used: had they been made on a larger scale; I see no reason why they might not have been used with advantage.

Some years after the lecture spoken of, I was requested to examine some flues at the house of an architect near Spring Gardens, who, I understood, had been at a considerable extra expense in building them with Hiort's patent bricks: and here my opinions were confirmed, for they had proved a complete failure, and simply from their forming so small a flue, as the following also will show.

Case 22. A kitchen chimney, in Tooley-street, had been built with the patent bricks; it was in an outer building, with only a loft over it, and smoked very much. I made several apertures in the chimney, and cut away the whole of the circular patent bricks, leaving the brickwork by which they were encased to form the flue (Cause 1). By this process the flue was enlarged from twelve inches to about eighteen in diameter, and it answered admirably.

Case 23. A few years since I supplied the stoves

and kitchen ranges at the governor's and matron's houses in a prison ; they were set by the workmen of the contractor for the building. When the houses were occupied the kitchen chimneys showed a great disposition to smoke ; the workmen who had set the grates, made several attempts and alterations to rectify them (assisted by an excellent smith, who had been employed at the building), including the application of blowers, &c., but without effect. In the end I was applied to, and readily accepted the task, fancying it a very easy one ; for, having observed small pots upon the flues, I expected that I had only to remove them, and place larger ones to accomplish the cure ; but, upon taking away the pots, I discovered, to my great surprise and annoyance, that the flues were circular and of a small size (Cause 1). I felt much vexed that I did not ascertain the dimensions before I undertook the correction of the flues ; had I done so, I should previously have asked the architect's consent to cut open the flues and enlarge them, which could easily have been done, as they were in the external walls (the coldness of which situation was another impediment to the proper action of the chimneys) ; however, by the kindness of the governor, I was allowed to reduce the openings of the fire-places from four

feet six inches to three feet six, and to make other contractions, which, with the addition of large pots, succeeded entirely; but this rendered useless a small hot-plate that I had previously placed in the fire-place.

Case 24. Within the last few days, and since the preceding part of this chapter was ready for the press, I was requested by an eminent builder at the west-end of London, to examine a chimney in Bedford-row, saying it was a very difficult one to correct, and that it would be a test of my judgment upon such matters. I immediately stated that if I could not correct it, I would at once say so; but that if I thought it practicable, I would proceed with the work, and that if I did not succeed, I would not take in any account for the same. This was said when two or three of his assistants were present.

I examined the flue—it was from an office that had been built upon part of the yard. The flue was taken immediately through the wall at the back of the fire-place, and then *nearly* horizontally, about twenty-five feet, upon arches across an open yard. The upright shaft was about ten feet high, and eighteen inches square outside, built upon the wall of the coach-house, in the rear of the house. The whole of the slanting flue, which had only a rise of about

two inches to the foot, and the upright shaft, were very much exposed to the cold, and at the top of the flue was a curiously formed zinc cap, nine feet long.

I was informed that the flue had been built by an eminent builder, living upon the Surrey side of the river Thames, about seven years since, and that several attempts had been made to correct it, and the last year by a *regular professor at chimney doctoring* !

When I first saw the chimney, I said that my friend had given me what he promised me—a severe test, from the cold situation of the shaft, and more particularly from the almost horizontal flue ; but, upon recollecting what could be done by a good shaft to overcome the impediment in the cold horizontal flue, I immediately directed the shaft to be taken down, when I found it was a circular flue, of only nine inches diameter, built with bricks, four of which formed a course of nine inches diameter inside, and eighteen inches square upon the outside ; and each alternate course was formed with four bricks straight upon the outside, and circular inside, with four half bricks upon the corners, to make the bond.

I then directed a flue to be built fourteen inches square, in the clear, being about three times the size of the old flue, and a case of four-and-a-half-inch brickwork to keep the flue warm (as in Case 1) ; upon

the top of which I caused to be placed a five-feet earthen chimney-pot. The new shaft being three times the size of the circular flue, I consider equal to having raised the old one twenty feet or more, as the new shaft was, by the outer case, protected from cold, while, by raising the old one twenty feet, the whole thirty feet would have been all four sides exposed to the cold.

The fire was lighted before the scaffold was removed, or the work dry. It performed admirably.

I could have placed a metal tube upon the top that would have been more efficient than the earthen pot; but I am anxious to convince the public that such contrivances are not necessary, when a proper flue is constructed; and, in this case, there was power sufficient, without the assistance of a cap.

Should any doubt still exist with regard to the *principle* I have all through advocated, this case would be convincing as to the power created by *size* and *warmth*. Though the new shaft and chimney-pot are three feet shorter than the old shaft and cap, and subject to the same eddies, and near the same high buildings, and the horizontal part exposed to the cold, it performs as well as any flue in London.

CHAPTER VII.

Examples in the Building of two Fire-places to one Flue, and in the correcting of others so built.

AMONG the "causes" of smoky chimneys I have named the having two fire-places to one flue; this, by many, is considered an insurmountable difficulty: but I shall hope, in this chapter, to prove to the contrary.

Case 25. I was requested to construct an open fire-place in an office, where a close stove had been previously used, the pipe of which was inserted in the flue of an adjoining room, having an open fire-place; but, in neither of these offices did the smoke go up this *one* chimney satisfactorily. The shaft was rather short and only of the usual size; and, although the office was lofty, there was but one storey above it, and the flue was considered inadequate to do the work of a second open fire, if added to it (Cause 7).

I directed the flue from the second fire to be carried up the whole size of the opening for the stove, which was thirty inches wide by nine, from back to front ; it would have been preferable to have been fourteen inches deep, but for encroaching upon the size and appearance of the office.

When I proposed to the bricklayer to make the flue thirty inches wide the whole height of the office, which was ten feet above the chimney breast, for a grate only thirty inches wide, he thought the idea very extravagant, and even hinted that he considered me a fit subject to become a patient in one of those asylums which, I am very sorry to say, are very numerous in the vicinity of London, rather than to direct the building of flues ; but I told him my plan would save materials and labour, an important point at the present time !

When near the ceiling, an opening was made into the old chimney common to both rooms. The reason of my having the flue built so large was, to create a power equal to a flue of the usual dimensions, and twenty feet high, or double the length of the one in question ; and by removing a small chimney pot, and putting a larger one in its stead, I allowed for the free escape of the smoke from the two fires, thereby rendering the new fire-place very efficient, and the

old one much better than when the pipe from the close stove was introduced into the chimney at a lower point.

Any number of flues may safely be carried into one, proportionably large, shaft, provided that each has a sufficient length of flue before entering the common shaft, upon which it should not be dependent for any assistance, if it can be avoided ; for suppose the shaft to be constructed to take off the smoke from twelve fires, and only half or one-third of that number should be required (from the heat of the weather, or otherwise), it is quite clear that the shaft would be much less powerful, from the want of heat, and probably from the entrance of much cold air through the flues that are without fires, and, in that case, artificial heat, or a fire kept specially, would be necessary to keep the shaft hot, and which would be quite unnecessary if the flues were carried up a sufficient height before entering the common shaft.

Case 26. In a laundry at the top of a house, a washing copper was set, the flue from which was carried up, in the usual way, about three feet, and then let into the shaft of the kitchen chimney which passed through the room. I was much surprised to find that, though the entrance was made into a flue that was always warm, the smoke from the copper

fire would not enter it ; but, that the smoke from the kitchen fire turned down the flue of the copper, and passed, between the furnace-bars, into the laundry. The bricklayer who set the copper was much astonished at the occurrence, and, as he could not suggest any remedy, left the house. I was equally at a loss to account for what I thought so strange a phenomenon, and several hours elapsed before I could do so. It occurred to me that as the chimney-pot (Cause 2) upon the top was less than the funnel of the kitchen flue, the smoke could not escape at that point so freely as it should, and, therefore, availed itself of the first other means of exit, and was in part discharged down the copper flue into the room : and this must have been the case, for when I enlarged the opening at the top of the shaft, the smoke from the kitchen fire passed freely upwards, without descending into the laundry ; and when the copper fire was required to be lighted, the smoke from it was kindly received into the kitchen flue, and so passed off together the smoke from both fires. The medical gentleman at whose house this happened, and who had attended my family for more than thirty years, would not admit that the effect was produced by simply enlarging the "top," but all answered well afterwards. The case was similar to a river, or

running stream of water, which being impeded or contracted in its passage, would either rise to a higher level, or escape by some neighbouring creek or outlet, as the smoke did through the copper fire into the room.

Case 27. At the completion of some repairs at a house of a Baronet, in the enclosure of the Regent's Park, and soon after the family had commenced occupation of the same, it was discovered that the fire-places of two rooms adjoining each other upon the first floor, had but one shaft for the two fires, and that the flues were united about two feet above the chimney breast, with a very bad result (Cause 7) : had they been united higher up, and the flues of larger dimensions, there would have been nothing to prevent their answering.

A West-end upholsterer suggested to the clerk of the works that I should be called in, and that if I said it was practicable to correct the flues, to allow it to be done ; and, that if I reported against it, to abandon the idea of correcting *those* flues, but to carry up another in the following spring. I stated that they were capable of much improvement, and that, if altered, might be used with tolerably good effect. I supplied two stoves, with small openings in front, and set with fire lumps, having well-fitted

register tops, so that if only one were in use, the other might be kept shut; or that if they were both in use at the same time, the registers were intended, and so constructed as, to be opened only just enough to permit the ascent of the smoke. My object in thus confining the mouth of the chimney was, that as little cold air as possible might be allowed to enter, and thus to become an impediment; the flue common to both fire-places being both small and short. They answered very satisfactorily. I had previously corrected four chimneys for the upholsterer who recommended me, and who said he supposed he must pay the amount of the contract, though he had "no fuss or dirt" for his money, as the work was completed in two hours, while many of his friends had had dirt about for a week, and the flues no better.

Case 28. A similar case to that in the Regent's Park occurred in Bloomsbury, only that one of the fire-places was a story above the other: the upper one having been a shop, without any flue, was converted into a sitting room, and in it a fire-place was made, for the smoke from which the builder had availed himself of the kitchen flue, which was in constant use: this caused both chimneys to smoke, and all attempts to cure them failing, the builder could

only advise the carrying up of an extra flue through the house to the top; but, as I had been known to them many years, my opinion was asked. I again resorted to the lessening of the fire-places (as in Case 23). In the kitchen I reduced the opening of the fire-place above the range as much as could be conveniently allowed, and I put a register door in the chimney. In the sitting room I supplied a stove with fire bricks, and a well-fitted register door that, as in the former case, either door might be opened or shut; and the gentleman was much pleased with the result.

Case 29. The house of a clergyman at Margate had been raised one story, and a fire-place made in the third floor, without any flue for the same; but for which was substituted an opening into the shaft of the kitchen chimney, about twelve inches above the bar of the attic fire-place. This was a total failure, and the fire could not be used in it. The kitchen was a spare one, and seldom required; but, when it was, the smoke would not pass off at the top with sufficient freedom, and so was partly discharged into the attic (Case 26). I very much wished to take the flue from the attic into the kitchen chimney, at a point two or three feet higher up (Case 25); but I could not do that without a considerable cutting

away and destroying of the paper of the room ; therefore I fixed a register stove, with a small opening and the *fire very low*, which was, in fact, the lengthening of the flue twelve inches at the bottom. I also placed a galvanised iron cap upon the top, about two feet longer than the chimney pot (thereby gaining about two feet more in length of flue), and large enough to allow the smoke of both fires to escape, should they both be in use at the same time. I then fixed a register door in the kitchen flue, a short distance above the chimney breast, to be kept shut when a fire was not required in the kitchen, and when a fire was required, to be opened only just enough to let the smoke escape, and the heated air would not be so detrimental to the attic fire as cold air passing would be. Both performed admirably at the same time.

CHAPTER VIII.

Examples in the use of Two Flues to one Fire-place.

IN situations where sufficient height of flue cannot be obtained, a large flue, *or two* lesser ones may be used.

Case 30. A chimney was required for a lodge, at the entrance to a garden, consisting of a ground-floor only; it was impossible therefore that the flue could be other than extremely short. The lodge was surrounded on three sides by lofty houses (Cause 6), and the fourth exposed to the garden; this added to the disadvantage of the short chimney; for, as has been previously remarked, the wind passing over the high buildings would fall directly upon the top of the "low chimney." Under these difficulties, I directed that two flues, each fourteen inches square, should be built for the one fire-place, and to be of four and a half inch brickwork, with an outer case of four

and a half inch work around the whole, to keep off the cold and damp. The chimney shaft above the roof was consequently five bricks and a half wide outside, by three and a half bricks thick, and which as it stands alone nine feet above the building, which is only of about ten feet elevation, in a very public situation, has an appearance much less unsightly than a shaft of the usual size for one flue would have had, besides being more substantial and of double the power.

This use of a *second* flue is frequently very convenient; for, when a weak and inefficient flue is found in a *stack* of chimneys, it is not always possible to enlarge it, and then recourse may most advantageously be had to the use of a second flue to give additional power.

Case 31. A flue of a kitchen, on Holborn-hill, where cooking was to be done for a hundred persons, was on the first floor; consequently, the chimney was only about thirty feet long, and being of the ordinary size, was not sufficient to carry off the smoke from a fire so large as was there required, and much less, to turn the smoke-jack with joints suitable to such a number. Before I was called in, the chimney had been improved, but still remained feeble; indeed, it was impossible that *that* flue alone

could be other than feeble. I therefore took advantage of the chimney which ran up beside it, from a room where a fire was not used, in the next story, and into which chimney I made an opening from the kitchen flue, thereby assisting it by twenty feet of extra flue: this use of the second chimney was equal to the elongation of the kitchen chimney twenty feet, or to the increasing of it to nearly double the size. Immediately over the fire-place, in the upper room, I placed an air-tight iron door, to cut off the communication between the chimney and the room, but, of course, this "door" could be opened at night for the purpose of ventilating the room, or of having an occasional fire in the grate if required.

Case 32. The following is a similar case to the last: the kitchen on the first floor, and only two stories above it; the flue was of the ordinary size, fourteen inches by nine, with a wide fire-place. It was at a newly built house at King's Cross. The architect whom I met there said, that the chimney smoked so much upon one occasion, that all he could suggest for the moment was, that the fire should be put out. To increase the power of the flue, I wished to obtain the assistance of a second one, and, as I could not conveniently avail myself of that from the room immediately over the kitchen, I made an opening into

TWO FIRES TO ONE FLUE.



the attic chimney, and cut off communication with the attic by an air-tight iron door (Case 29). This gave an equivalent to ten feet of additional length to the kitchen chimney. The flue, however, laboured under another disadvantage: all the chimneys in the stack were covered over by stone work about a foot above the top, and brickwork carried up to the stone between each flue; thus the smoke, from the position of the stack, could only escape east and west, consequently, when the wind blew strong from either of these points, it passed so rapidly through the opening, that it was a great impediment to the escape of the smoke. I could not remove the covering at top without damaging the architecture; but I cut holes through the wyths or brick partitions of the flues, above the chimney and under the stone covering, thus permitting a small escape of smoke under the wind at any point of the compass; and I put small turrets at the side to break the force of the wind, which before had blown so strongly underneath the "covering" upon the chimney tops that it had almost entirely obstructed the passage of the smoke.

Case 33. In the case which I am about to mention, the double difficulty of insufficiency of flue (Cause 3), and of high surrounding buildings (Cause

6), presented itself. The flue of a small sitting room, built out at the end of a house, and having no room over it, was short, with one side exposed to the air, and the top surrounded by buildings much higher than itself. To compensate for the shortness of the flue, I was fortunate enough to find a spare one beside it, of which I took advantage. I connected the two flues, and at the top, I made them both to be received into one cap only, which I constructed similar to what is usually called a "wind-guard," so as to prevent, if possible, the wind, in falling down from the surrounding high buildings, from interfering with the action of the chimney.

When two flues are used for a small fire-place, I consider it much the better plan to unite them at top, so as to have but one cap; for I have known cases where there have been two flues with wide openings at top, that the air has gone down the one flue as low as the junction of the two, and up the other, carrying with it only a small portion of the smoke. I presume the cause of this to be, that the one flue being warmer than the other, acts like an inverted syphon.

Case 34. I will now give another similar case, which will be an additional proof, if such be wanting, of the advantage, or rather necessity, of chimneys

which have a large opening at bottom, being also large or long in proportion in the shaft.

At a wholesale house in Wood-street, the kitchen was one of the attics, the fire-place between four and five feet wide (Cause 4). The chimney had smoked desperately from the time of the building of the house; the landlord, who was a builder, had made many attempts, with long pipes and otherwise, to remedy the evil, but without effect. This, it must be evident to the reader, from what has been advanced, was a flue less likely to answer, and therefore more difficult to correct than one lower in the house; for, not only was the kitchen in the higher story, but it was very far from lofty, and the shaft above the roof was very short (Cause 3).

In still adhering to the old principle, that the quantity of rarefied air in a small or short chimney, is not sufficient to carry off the smoke from a fire-grate with a large opening, I sought for means by which I might increase the size, and consequently the power, of the chimney in question. Upon examining the house, I had the good fortune to find, belonging to a lower room, a chimney which was out of use, in the same stack with the kitchen-flue, and which ran up beside it. Into this spare flue, as in the former cases, I made an opening from the

kitchen-flue just above the breast of the fire-place, and by this its power was nearly doubled, and no more smoke annoyed the people in the kitchen :— of course I cut off the communication between the second flue and the room from which it came ; or the cold air passing up it would have rendered the second flue of no avail.

Case 35. At a small, newly-built Shooting Box near Hatfield the occupants were much annoyed by smoke from the fire-places, especially from that in the keeper's kitchen, which had an opening of about four feet six. The elevation of the ground floor was six feet six inches, with one floor above it also of low elevation, so that a tall man could nearly reach the tops of the chimneys from the garden (Cause 3). The fire-place in the room over the kitchen was seldom required to be used, therefore I availed myself of that flue, by adding it to the kitchen chimney and placing a register door over the fire-place, to prevent the air from passing when not in use, but so as to open if required. This was equal to having elongated the kitchen flue about six feet, and the result was quite satisfactory.

Case 36. In some cases the smoke-jack is a slight impediment to the ascent of smoke in the kitchen chimney, especially if the "flies" are not proportion-

ately large, or the "fans" wide enough apart; but I never recommend the removal of the "jack," so useful in other respects (as I contend that no meat is so good roasted by any other means as on a spit, placed horizontally, the rotary motion of which causes the fat to flow round the meat, and thus to baste it; while, on the contrary, with meat roasted in a vertical position, the fat flows down as soon as warm), but, rather that the chimney be properly built, or altered, as in the following case, which occurred at an establishment under the Corporation of London where I was correcting some flues. The smoke did not pass freely from the kitchen fire-place, which was about seven feet wide, and was upon the dining-room floor; but, though shorter than if in the basement, it had two flues, and therefore could not want enlarging or elongating. I discovered that the smoke did not pass the fly of the jack as freely as it should, and so I caused an opening to be made, within the chimney, outside the iron hoop of the jack, about nine inches by four, or thirty-six square inches, which allowed part of the smoke and air to pass without acting upon the fly, and still left power enough for the jack.

CHAPTER IX.

On preventing the *Descent* of Smoke in Flues—and on a necessary Supply of Air.

THE subject to which we are now brought, is one which gives rise to many complaints, and which I also consider presents much difficulty in practice ; for, if the operator is successful in preventing *smoke* from descending a chimney, the *air* frequently continues to do so, and which, in its passage, coming in contact with the soot, as of necessity it must, will smell much like smoke. The descent of the air and smoke in a flue arises from a variety of causes, one of which is coldness of the flue ; for, when a chimney is colder than the room to which it belongs, the cold and heavy air from it will descend into that room containing warmer, and consequently lighter air ; and as the air descends the chimney, it will frequently bring with it the smoke from the adjoining, or sur-

rounding, chimney tops. At other times it arises from there being a fire in an adjoining room which is not otherwise well supplied with air; or from other rooms in the house having fires, and drawing the air necessary for combustion, &c., down the spare flue; and though the chimney *tops* may be so arranged that those chimneys in use would, if perfect, have the smoke carried completely away, I have known some few cases where the wyths have been faulty, or split, from being composed of inferior materials, or workmanship.

Case 37. A case of this kind occurred at a house upon the west side of Russell-square. I was endeavouring to prevent the smoke from coming down the other chimneys, by elongating those most in use; so that the smoke from them should be carried above those that were out of use, and by that arrangement, when there was a downward current, allowing only the air without the smoke to descend. A man was at the top of the chimney while a fire was lighted in *one* fire-place, and he discovered smoke ascending *two* flues, and, upon closer inspection, he further discovered that the smoke made its way through the wyth from the flue where the fire was lighted, into the adjoining flue, but fortunately, it was only the chimney-shaft above the roof that was faulty, so I

ordered holes to be cut into the flues sufficiently large to enable the workmen to repair the same.

Case 38. In a set of chambers in Gray's Inn, where there were usually two or three fires burning at the same time, the smoke came very much down the flue of a bed-room where a fire was seldom wanted; and as this smoke came from the tops of chimneys belonging to other persons, we could not have any right to lengthen them. Therefore, the only safe remedy was to fix an air-tight door in the bed-room chimney, above the stove, which had the desired effect; and if a fire were required, the air-tight door could be opened; and when the air in the chimney became rarefied, an upward current would there be produced as much as in any other flue in that set of chambers.

Case 39. At a house in Hampstead, much smoke descended the flue in one drawing-room, when a fire was used in the other. This occurred from the rooms not having a sufficient supply of air (Cause 8) in each room; by reason of which, when a fire was used in one room, air came down down the flue that was out of use to supply that fire, and brought with it the smoke from the adjoining chimney pots. To correct this evil, I supplied air gratings under each fender, and elongated the chimneys of the upper rooms, so

that the smoke from them was carried much above the tops of the drawing-room flues, and could not readily descend them, though it might be possible that air would sometimes do so, and which I did not promise to prevent effectually, while still I was in hopes that the air admitted through the gratings, would very much improve the rooms. I am happy to say the lady occupying the house said, she never discovered a sooty smell after the alterations had been completed, and directed that other sitting-rooms also should have air-vents fixed. This arrangement likewise produced another good result, in causing the rooms to be more warm and comfortable; for, in proportion to the quantity of air admitted under a fender, or any other convenient point, *near* the fire-place, so much less will make its way from the crevices at the doorways, windows, etc., which necessarily passing by, and against, the persons using the room, may endanger the health, by causing them to be in a current of air. This current of air also tends much to cool the room, by pressing the warm air forward to the chimney and the colder taking its place; but, when the air is admitted near the fire-place, a large portion of it will supply the fire and chimney, and not put the warm air of the room much in motion, and thereby cause that the room be suffi-

ciently heated with a less quantity of fuel, and so will a less supply of air be required. Cold air rising near a fire, will not carry off the heat as many persons would suppose; as the rays of heat pass through the air, and are only stopped, or absorbed, when they strike against the walls, ceiling, furniture, or what other substance they may come in contact with; the heat is then diffused from those substances.

If the necessary supply of cold air is admitted near the top of the room, it will be found an excellent plan to keep the room cool, and to render the fire less efficient for what it is usually intended, namely, giving warmth; and, as is said by Count Rumford, of whose works I regret that I never saw a page until within the last ten days, "An Englishman who likes to see what is called a roaring fire, even with its attendant inconveniences of roasting and freezing opposite sides of the body at the same time, may have that indulgence by admitting the air at the top, or at the opposite side of the room to where the fire is situated."

Case 40. At a vicarage house near Newgate-street, two rooms had an inadequate supply of air, from the joiners' work being so well executed. I exchanged the stoves for others with small openings and fitted with fire-lumps. The chimney being in an external wall,

I readily obtained a good supply of air, and conveyed it under the hearth to holes made in the slips of the stove near the plynths. In one of the cases the air came in so strong, being admitted only on one side, that, upon making its way towards the fire and chimney, it acted rather too powerfully upon the smoke and flame that issued from between the fire-bars of the stove, and required a little regulating.

Case 41. At a house in Montague-street the chimneys were rather smoky, from want of a good supply of air. I caused air-gratings to be supplied under the fenders in the principal rooms, which was so satisfactory, that the proprietor requested to have some fixed in the chambers on the second floor, where a mason had been employed, who very neatly reduced the openings of the fire-places, and fixed caps upon the chimney tops without being quite efficient.

I could give fifty more cases, if necessary, at private houses, public offices, and offices connected with the Court of Chancery, but I think the above will be sufficient for the purpose intended. I have sometimes admitted the air under the stove, but this is very liable to distribute the dust into the room. The most efficient and certain method of preventing the descent of smoke in a flue *from other flues* is, to fix a door which has been properly fitted and ground so

as to be air-tight: but, if the fire in such a chimney be in constant use during the winter season, the consequent frequent opening and shutting of the air-tight door, is attended with trouble, and which, if neglected, the effect is not obtained; therefore, I recommend that those chimneys which are most in use should be elongated if possible at the top, so as to carry the smoke above those that it previously descended, and, if that is not satisfactory, air should be admitted into the room, at some convenient point *near the chimney*, to prevent the downward current.

If these last means do not succeed, I know of nothing else that can be efficient but an air-tight door.

CHAPTER X.

On Coring and Cleansing Flues—Climbing Boys, &c.

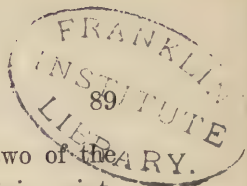
THE next subject for consideration may be thought by some of little importance; and possibly some of my readers may deem it a waste of time for me to write, or them to read, upon a matter which seems so likely to enter into the minds of all, as not to require any advice to enforce its practice.

Though I must confess that it would appear a perfectly natural course that the first inquiry respecting a chimney should be, whether there is a proper passage through it, yet I have often commenced operations upon the supposition that the flue had been properly cored and cleansed; or, from the assurance to that effect, from either the builder or the occupant of the house, and from this cause I have, at times, been subjected to so much annoyance, that after hav-

ing directed the construction and erection of an intricate machine, I have frequently attended to see the proper lighting of the fire and efficient cleansing of the flue.

I would strongly advise those who, upon undertaking the correction of flues, cannot discover any of the causes of smoke that I have named, or that their own minds can suggest, that they should first see that the cleansing is properly performed, for from the want of this have chimneys continued to smoke, even after I have corrected those errors which were the most apparent. I will cite a few such cases among the large number with which I have been concerned. The first case, it will be seen, presented two causes of smoke extra to that which is the subject-matter of this chapter.

Case 42. Many years since I was taking orders for a kitchen range at a house upon the Uxbridge Moors, when I suggested to the architect that the flue from the kitchen was very inadequate (Causes I and 3) to the work it would have to do, and also the propriety of taking advantage of another flue close at hand to assist it, which was done. Shortly after the works were completed, I was informed that the chimney smoked, though they had adopted my plan. I attended, with the architect, and we found that the



kitchen had three entrances, and when two of the doors were open, with the wind at a certain point, there was such a complete whirlwind (Cause 11) that the smoke was driven out of the fire-place, before it had risen to the chimney-breast; the same as if bellows are used to a fire obliquely the flame and smoke will be blown to the contrary side, and as you cannot hold a hare till you catch him,* so this chimney had no control over the smoke which it had no hold of, and which was driven away by the wind, before it reached the chimney-breast.

The architect proposed placing a screen, with a seat inside like a settle in a country ale-house, which prevented the "whirlwind," and the thing was accomplished.

Some considerable time afterwards I was applied to, as the chimney smoked again, and upon examining the same I found that, from the change of sweep or otherwise, the flue that I had caused to be added to assist the original flue was full of soot (Cause 14), and, consequently, useless, and the chimney was reduced to the same feeble state in which I pronounced it to be at first, and before I had tried it; but by the application of the old fashioned brush, in the shape

* Megg Dodds, in her cookery book, when describing the best way to cook a hare, says, "*First catch your hare.*"

of a human being, so long used to the disgrace of the present and former generations, all was right. I am, however, happy to say, that by the strenuous exertions of several gentlemen (among whom I shall, for their perseverance, ever recollect the names of William Tooke, Esq., Robert Steven, Esq., and others, to whom I gave some feeble assistance) the subject received its due consideration. I well remember attending a meeting at the Egyptian Hall, about the year 1810, convened for the purpose of endeavouring to supersede the use of climbing boys, when it was said, that the flues already built could not properly be cleansed without them. An Honourable Baronet (the late Sir F. Burdett) then replied, that if a bill were passed to prevent the use of boys, means would soon be discovered to cleanse the flues without them. But not till after many years had elapsed, and many thousand more intricate flues had been constructed, was the point gained, and this, I may almost say national disgrace removed. I could not, for some time, understand why the sweeps of London made such a resolute opposition to the change, as it appeared to me there could not be any particular pleasure in sending a boy up a chimney more than a brush or stick; but now for the grand secret of this "resolute opposition," which was, certainly, worthy to have been animated

by a better motive than the desire of gain, to the detriment or injury of human health, and, in some cases, even at the sacrifice of life. One of the sooty fraternity at length enlightened me upon the subject, by saying that a gentleman's gardener, or other person about an estate or house, could push a brush up, although he could not so easily get a boy that had been trained to such work; and thus, their trade was likely, as they feared, to come to nought.

I attended a committee of the House of Lords upon a bill to prohibit the use of climbing boys, when I suggested a plan (and produced a model of a chimney) also to supersede climbing boys for the coring of flues, which was, to leave out, or lightly place, two or three bricks at each angle of a stack, that the core could be removed and the bricks replaced, before plastering the house. It occurred very lately, that for the want of some such arrangement I had a bricklayer and sweeps nearly a week getting a passage through a flue which was wanted to be used for a descending stove; and one of the same sweeps told me that a flue at the House of Lords occupied three weeks in the coring.

Case 43. Another case of neglect to sweep the chimney occurred in Cockspur-street. The front of the register stove in the first floor, had been taken off to be repolished while the house was under

repairs, and when it was refixed the chimney would not take off the smoke. I was applied to, and in reply to my inquiries, the proprietor of the establishment assured me all the chimneys had been swept, and, that to make certain, a man had been stationed upon the top of the building to see the boy through each of the flues.

After trying to warm the flue in the manner I have before suggested; namely, with paper and other light substances, and also wasting much time, I requested that a sweep should be sent for, as I could not see any fault in the flue and still it would not perform.

When the boy ascended, he found that the flue turned off at a right angle at about the height of the room, and then, after proceeding horizontally about six feet, it turned up at another right angle, at which he found a considerable quantity of rubbish and soot (Cause 14), which had fallen down during the repairs, and after clearing that part, he continued his way up the upright shaft: upon his return the collection of soot from the shaft was so great that the boy said he could not turn the angle to come down. I was dreadfully agitated at having been the means of sending the boy up the flue, *though it was at that time the usual practice*, and was so

alarmed at the moment as not to recollect that we could have taken him out at the top of the chimney—after much exertion, by pushing the soot and other matter away with his feet, he succeeded in passing the angle, and came down the flue, leaving it to perform very well.

Case 44. A similar case occurred in Hatton Garden. I had corrected the kitchen flue, and after about two years I was applied to, as it smoked again: I requested the proprietor to send for a sweep; he replied, that it had been swept about ten days back, I stated that I would much rather see it properly cleansed before I attempted any other remedy; and when the sweep came, I told him that I wished to see the brush through the chimney-pot; he then desired the boy to go for more sticks. I presume that if I had not been there the sticks would have been sufficient, and the soot at top might have remained in the chimney!

Case 45. At a house upon the west side of Montague-square, I had corrected the kitchen chimney; and some months after it smoked again. The flue had lately been swept, as I was informed—I examined the bottom of the same and could not see anything wrong; I suspected that the brush had not been through the chimney pot, and therefore

I engaged a man to examine it, but all was apparently right. I then proposed that I would send a man to see it properly cleansed, at which time the sweep went up the flue a short distance, and returned with the brush of a machine, which had evidently been left in the chimney from the previous sweeping, and which obstruction in the passage was the cause of smoke; but the sweep, not being willing to admit it, said that he brought two machine heads with him, and the cook told her mistress, that it was quite common for sweeps to bring two or three heads for the machines with them; evidently to make it appear that I had not properly corrected the chimney, but it did not smoke afterwards.

Case 46. A friend of mine, near the City-road, was annoyed with smoke in some of his rooms, just before the bill prohibiting climbing boys was passed: yet a machine-sweeper was sent for, and while he was at work, a large lump of soot in the shape of a chimney-pot fell from the top of the house: one of the servants came down stairs alarmed, and said, the man had pushed one of the pots off. The fact was, the climbing boy had not cleansed the top for a considerable time, but the machine, in passing through, pushed the soot out in a body, which had fallen into the street.

Case 47. The following case is one of those which induce me to urge upon builders and others, the propriety of having chimneys well examined before attempting any alterations. I had supplied a kitchen range at a new house in Finsbury-circus. I was afterwards applied to about the chimney, which smoked very much. I immediately inquired of the proprietor if the chimney had been cored, he assured me that it had, and that a boy had been to the top. I removed the small chimney pot and placed a larger one in its stead, and also made a slight alteration at the bottom of the chimney; both without much effect, and as I had neither built the chimney nor supplied the bricklayer to set the range, I left it in the hands of the builder, who afterwards informed me, that he had employed a climbing boy, who found the chimney nearly closed in one of the angles, with the rubbish that had fallen into it during the building.

Case 48. In the following case I was somewhat puzzled; for I was called upon to correct a flue which seemed to me a well-built one, that is to say, built in good proportions. It was at Ware in Hertfordshire; a kitchen chimney of sufficient size and good height, with only one side exposed to the external air, but the smoke did not go up freely. As all appeared

right at top and bottom, I concluded that the fault must lie elsewhere; I therefore ordered an opening to be made into the flue from the outside of the house, about three feet above the floor of the drawing-room; and *there* was discovered a common round earthen chimney pot actually built up within the chimney! The builder came down from the ladder apparently much alarmed, and expressing his surprise, not only at finding the chimney pot in such an extraordinary situation, but at my directing the hole to be made just at the place where the impediment was; he seeming impressed that, in my so doing, I must have had the assistance of more than natural agency, and was almost fearful of continuing in my company. I did not choose to tell him what led me to *suspect* that we should find the impediment at the point we did: but the fact was, that upon examining the different rooms through which the flue passed, I discovered that in a small room on the first floor, adjoining the drawing-room, a furnace *had been* erected to heat a bath, and though *out* of use, I thought it just possible that the kitchen chimney might have been injured, either by the making of the flue from the bath into it, or in the taking it down again. This accounted for the obstruction, the removal of which cured the chimney.

CHAPTER XI.

Directions for the Construction of Flues, with Remarks upon the fixing of Chimney-pieces, Stoves, &c.

THE part of the following chapter relating to the actual construction of flues will, necessarily, be very short; for if my opinions be correct, or any way bordering upon it, I can, in very few words, give sufficient information to the operative builder, to direct him in the construction of the flues of ordinary dwelling-houses; so that they may perform their office without those various additions which, at the present day, we see so unsparingly used upon the tops of chimneys, especially of modern buildings.

As is the case with any bodily pain, every one pretends to know the best remedy; so with chimneys, every one is ready to state the cause of smoke, and to prescribe a remedy for the same, and this without much relief to the old flues, or much improvement to

the construction of new ones. Some assert that the chimney is too straight, others that it is too crooked: some that the flue is too large, others that it is too small: some that the breast of the chimney is too thick, and very many add to this that the stove is set much too forward; but I am bold to assert that if any one will say, what sort of chimney will be required, for any building that is to be erected, or what route they wish it to take, whether it be required as straight as the letter I, or as crooked as Z, I will accommodate them, and guarantee its performance.

With regard to a chimney being too straight, I cannot see any impediment in a straight flue, not being able to bring myself to believe that the remarks made by a gentleman at Ware many years since were just. He said that his *chimney smoked from being too straight, as bends in a chimney give power, as do bends in a river to water running; or, why did Sir Hugh Myddelton take such a circuitous route with the New River (which takes its rise close to Ware), but to give it a current?* I believe it is very generally known that the late Sir Hugh Myddelton took a circuitous route to obtain levels, as much as possible, and, at times, to evade those shameful demands, made by persons for the land, which ultimately

brought the noble work of a great mind to a standstill, he having commenced the same without having first obtained an Act of Parliament to compel the sale of the ground at a fair valuation.

The kitchen chimney, Case 8, was as straight as the letter I, and when it was nearly up ready for the chimney pot, I remarked to the bricklayer who was building it, and who appeared to be an excellent workman, that if the sweep slipt while cleansing the flue he would fall to the bottom, it being so straight it would be impossible he could stop himself. The builder acquiesced, and continued, that he thought it would be very liable to smoke too. I desired him to make himself quite easy upon that subject, as I was quite satisfied it would not do so, except it were full of soot.

I have known many chimney shafts to have been taken down and rebuilt in a zigzag form, evidently with a view to give extra power to the flue: but I cannot see upon what principle those persons found their theory. If they argue that bends cause the chimney to be longer, I must admit the argument; but I still have to learn that the length *so produced*, gives additional power. For, as a column of water exerts a force agreeable to its altitude, without reference to the pipe that conveys it being straight or

crooked, the power of a chimney depends upon its altitude, size, and difference of temperature between the heat of the flue and the heat of the room; for, the more the air in the flue is heated, the more freely will the air in the room press forward towards the mouth of the chimney, exerting its force upon the rarefied air, and thus giving power; and, if a chimney be sloping, or zigzag, it will add to the length, but will not add to the altitude.

With regard to the next assertion, that "chimneys smoke from being too crooked;" I never knew one to smoke from that cause; and, were they likely to do so, certainly the chimney which I constructed, Case 9, was crooked enough to have been among the number.

With regard to the remark that "chimneys smoke from being too large;" I can safely say, that I never knew a chimney to smoke from the large area of the same, and, that I generally approve of having large flues, may be inferred from the fact of the number of cases I have recited, where I have enlarged those which I considered to be too small. For the *larger* the chimney is built the greater will be the difference of the weight of the column of heated air *in* the chimney shaft, and of another column of air, of the same altitude and *diameter*, *outside* the chimney;

and consequently, the air will enter with greater force at the bottom of the flue, and carry up the smoke with more rapidity along with it.

The disposition to build small flues has become very prevalent. I have inspected many large buildings, during their erection, with flues nine inches square; and, at a meeting of a committee, for building a large establishment, where I attended and proposed to direct the flues, so that they might not smoke, a Noble Lord, the Chairman, remarked, that since climbing boys had been dispensed with, *chimneys could be built so small as to prevent their smoking!* One of the members of the committee rejoined, that in the house where he resided, there was a chimney, which he thought large enough to contain the whole of his family; yet it did *not* smoke. To return to the "building;" the architect did not like to be interfered with, so they proceeded with the small flues, though the same committee, under the advice of another architect, had just completed a large building with similar flues, and which had cost a very considerable sum of money in the endeavour to correct them.

With regard to the remark, that "chimneys smoke from being too small:" I need only refer the reader to Cause 1 and numerous "Cases," that my concur-

rence in the remark may be fully known. With regard to the assertion, that the "chimney breast is too thick :—" I have known many cases where persons professing to correct flues have cut away the inside of the chimney breast, because they perceived the smoke to strike against it, and then come into the room : but this usually arises from some other cause; for, if the draught (if I may be allowed to use the expression) is good, the smoke and flame will always make to the back of the fire-place, from the pressure of air in front making its way to the chimney (Case 17). With regard to "stoves being set too forward :—" I think I have before stated it to be a very prevailing opinion, that stoves should be set so that the front of the fire bars should be immediately under the *inside edge* of the chimney breast ; but for the reason then adduced, I contend that it is not necessary to adhere to this plan, and it would be exceedingly inconvenient so to do, where box chimney pieces are used ; they being fixed upon the *face* of the brick-work, the stove would look very unsightly if fixed farther back in the fire-place than the inside edge of the *chimney piece*. If the thickness of the "breast" is any impediment, it cannot be so in the case of a register stove, as the front of the same forms an artificial chimney breast of only its own thickness,

which is usually about three-eighths of an inch; therefore, whether the stove be fixed forward or backward, this artificial breast or front of the stove moves with it and continues to keep the same relative position, and therefore cannot possibly alter the action in any way; but even in this, which appears to me not to admit of a doubt (though it might with half-registers or kitchen ranges), I have known many eminent builders to allow register stoves to be set further back, and marble or iron slips used between the stove front and the box chimney piece, much to the detriment of the appearance, and without any good effect.

Having, I trust, satisfied the reader that there is not any better position for a register stove to be fixed in a fire-place, as well for appearance as for the action of the smoke, than the face of the brickwork, or inside edge of the box chimney piece; that situation must be preferable, as it frequently gives a facility to improve the appearance of the room.

In many old houses, and some new ones, the fire-places are built with the jamb on one side wider than that upon the other (in consequence of having more flues upon one side than upon the other, or of having a flue from below upon one side, and not any upon the other, and the builder or architect being re-

luctant to use the bricks and space to make the jambs even, by widening the narrow one) and the chimney piece made the same width as the brick opening, whether it be large or small; and fixed suitably to *it* whether it be in the centre *or not*, of the projecting brickwork of the chimney; when, by a little arrangement of the mason in making and fixing the chimney piece, he could usually supply, in a good upper room, having but a small opening, occasioned by there being many flues in the same stack, a chimney piece of any width that might appear *suitable to the room*, and wider than the opening to the extent of twelve inches, or any intermediate size.

If one jamb is larger than the other, not exceeding fourteen inches, and the opening of the brickwork is as large as required for a suitable stove, the chimney piece could be made the size of the opening, and fixed seven inches, or any less distance, on one side of the brick opening, and thereby show equal margins on each side, from the ends of the mantelshelf, to the angle of the projecting brickwork of the chimney.

A few days back, I saw a very neat building, I believe intended for a small inn, in Middlesex, only a few miles from London, and in the principal chamber upon the first floor, one jamb was eighteen inches

wide, having a flue from a lower floor in it: and the other jamb only nine inches wide, with the chimney piece in accordance with the brickwork: had the mason fixed the chimney piece four and a half inches from the brick opening, *upon the jamb* that was eighteen inches wide, and added four and a half inside the fire-place to the nine-inch jamb, the chimney piece would have been central to the brickwork, and a register stove the whole size of the opening, as originally intended, and to fit the chimney piece, could have been fixed; as the front of the register stove, on one side would stand before the face of the four and a-half inches of brickwork which would be inside the chimney piece, upon that side where the wide brick jamb was built. I have seen many hundred such cases that could have been readily improved; and, within the last few days, a newly built large house, in Holborn, with many of the fire-places similar.

From the fear that what I have just advanced may not have been clearly understood, I will now proceed to describe two or three cases where I have actually made the alterations in question.

Case 49. About the year 1828, a new party-wall was built to my late residence in Holborn, having the flues of the adjoining house worked into the

same wall, for the back rooms, as those of my own house; consequently the fire-place upon the second floor was only twenty-four inches wide, and a chimney piece of the same size was there fixed. Several years afterwards, I wished to make the chamber into a sitting room, and a stove, twenty-four inches wide, would not have had a very good appearance for a room nearly twenty feet square.

I was contemplating upon the propriety of cutting away the two adjoining wyths, and of substituting cast iron plates, which would have given me about eight inches more room; but I very soon saw that I had all the room I required without doing so. I directed a thirty-six inch chimney piece to be fixed at this fire-place, which was only twenty-four inches wide. By reason of the chimney piece being so much larger than the fire opening, there were six inches of brickwork on each side, within the chimney piece; and as the fire part or body of the stoves are seldom more than twenty-four inches, that part was placed between the brick jambs, and the front of the stove was fixed against the face of the brickwork and between the marble jambs; consequently I had the pleasure of seeing a thirty-six inch stove and chimney piece suitable to the room, which was built with a twenty-four inch fire-place.

Case 50. Many years back I called upon a friend in Gracechurch-street, who had nearly completed an alteration in a sitting-room, and had been at a very considerable expense in cutting away the front brickwork of the chimney, to enlarge and to improve the appearance of the room; a new marble chimney piece with slab and register stove had just been fixed, with a brick jamb fourteen inches wider upon the left side than the one upon the right, in addition to which the recess upon the left side of the fire-place, was between two and three feet wider than the recess upon the right, consequently the fire was inconveniently placed, and the room did not appear so much improved, as might have been expected for the amount of the outlay. I asked my friend how he could submit to have the chimney-piece fixed so much more towards the right than towards the left of the brick projection of the chimneys, which brickwork was also more to the right than to the left in the side of the room. He said it was very unfortunate that the fire-place was so much out of the centre, and what made it still more annoying was that he intended, for the sake of uniformity for the mantel-piece, to make an addition to the narrow jamb upon the right hand, so as to be of equal size with the one upon the left, but which addition would so much reduce the

already small recess, that his piano could not be placed there, where he had much wished it to be. I told him it was not necessary to make any addition to the brickwork of the chimney, which already occupied a large space, but to have the chimney piece removed about seven inches, which would make it quite central as well as leave the recess, as it then was, large enough to receive the piano. My friend said he expected his builder in about one hour, and would feel much obliged if I would meet him, and explain to him how I proposed to make the alteration. The builder arrived before I did, and hearing of the proposition, said it could not be put into practice, and after I explained to him how it could be done, he still persisted that it was quite impracticable. I again pressed the subject: he replied that the chimney piece was fixed in the usual way. I readily admitted that, and remarked that custom justifies many strange proceedings. The job was being done by contract, I said the alteration which would not take much more than one day must be paid for, and my friend, who agreeing to pay fifty pounds to have his room improved and decorated, would not object to pay one more sovereign to save having the recess in his room spoiled. After I had taken the front off the stove to convince the builder

of the practicability of the proposed alteration, he said he could not remove the stove enough by half-an-inch, which I said would be quite satisfactory: but when I called again the mason had removed it half-an-inch more than sufficient, and the space for the piano remained!

Case 51. Another case upon this point I cannot consider necessary; but I hope the reader will excuse me for inserting one.

At a newly-built house in Southampton-buildings I suggested that the fire-places in the upper rooms should be as central as possible, and of a suitable size, the whole house being intended for offices. The builder, who is, I believe, the oldest intimate friend I have living (having had the honour of his friendship about fifty-five years), appealed to me upon the propriety of the conduct of the mason in fixing his chimney pieces in so extraordinary a manner, and also wished to know if I could direct the setting of the stoves, which I was to supply, so as to answer properly. I replied that it was from the respect in which I held his long-continued friendship that I had intruded myself into his house, and directed those deviations from the general practice, believing that I should improve the appearance of the offices in which the deviations were adopted. The stoves

were all of suitable sizes, and set in the centre of the brick projections.

Case 52. There is also another error that I have seen in the construction of fire-places, which, by being named here, may possibly act as a slight caution. I was staying at the house of a friend near St. Neot's, who owns and cultivates the whole parish in which he resides. A drawing room was being added to his house upon the ground floor; and as there was not any excavation, the flues commenced upon that floor. The jambs were built nine inches each, and a fire-place about thirty-eight inches; therefore, it was quite apparent that if a suitable chimney piece were fixed, the marble shelf would run beyond the brickwork on each side, which would appear much out of character. I pointed out the error, and caused nine inches of brickwork to be added to each jamb upon the outside, which gave room for a handsome chimney piece, and also a place for the bell-pulls, between the chimney piece and angle of the brickwork; and as the cornice was not completed, it did not occasion much extra work.

I saw the same error at a newly-built house in Holborn a few years since, where the ground floor and basement were used for business, and the fire-places commenced upon the first floor; the jambs

were built nine inches each, in a handsome large room; and I believe it remains to this day, with the marble mantel-shelf passing the jambs on each side.

After reading the foregoing chapters, and the cases cited where enlargement of the flues has been resorted to with success, I think few will be bold enough to say that the flues built of late years, speaking *generally*, have been of sufficient size, or that some amendment in their construction is not necessary, though I am open to conviction to the contrary.

With due deference to public opinion, I propose the following dimensions for general rules, leaving certain cases to the judgment of the constructor; and while I might dilate upon the quantity of air per minute carried off by chimneys of a certain size, in comparing the heat of the flue with that of the apartment; upon the consequent necessary supply of fresh air, &c., &c., I will pass over these details, which are often tedious, and, for that reason, confine myself to my original intention of treating of *practice* rather than *theory*.

KITCHEN CHIMNEYS with small fire-places should not be less than fourteen inches by nine; and if the opening of the fire-place exceed three feet six inches in

width, the chimney should be fourteen inches square, or eighteen inches by nine, whichever way be most convenient in the arrangement of the building, only providing that the flue have an area of about two hundred square inches. But the square chimney is preferable, it being more suitable to the brush for sweeping than is eighteen inches by nine. If the opening of the fire-place exceed six feet in width, the chimney shaft should be eighteen inches by fourteen, or of an area of about two hundred and fifty square inches. If the chimney shaft be less than thirty-six feet in height, the sizes should be severally fourteen inches square, eighteen inches by fourteen, and eighteen inches square, in lieu of the above dimensions.

DINING ROOM, or ground floor, and DRAWING ROOM, or first floor CHIMNEYS in lofty houses, may be built in the usual way, fourteen inches by nine.

UPPER STORIES, the chimneys of which are usually ten feet or more shorter than the drawing-room floor, should have them fourteen inches square.

ATTIC CHIMNEYS should be still larger, till near the top, where they should be reduced, to keep out the weather, or to receive a chimney pot.

COTTAGE BUILDINGS, or detached houses which are usually low, should not have any chimney less than

fourteen inches square, and the upper floor eighteen by fourteen. When chimneys are exposed to the air and damp, by being in an external wall, it will be a considerable advantage if the brickwork can be left nine inches thick between the flue and external air, instead of four and a half inches, as is usual.

If a kitchen fire-place be required in the upper part of a house, and consequently the chimney cannot be long, it must be made up in size. I would recommend two flues of the dimensions given for low buildings, or one flue of double those given dimensions; the top to be reduced to about one hundred and fifty square inches, or, if two flues, about one hundred and fifty square inches for the two.

Having given the dimensions which I think necessary for the construction of flues for dwelling-houses generally, perhaps it may be advisable to state what I consider the best method for constructing the throat, or commencement of those flues.

The kitchen-flue is generally commenced first, and frequently it is required to gather it over very quickly on one side, to make room for the fire-place upon the floor above. It often happens that the commencement, or throat of the chimney is considerably out of the centre, and this becomes an evil (Case 21); therefore, I recommend that kitchen chimneys should

be gathered over upon each side, if possible ; and when that is done, the direction of the flue afterwards is of very little importance, providing that it can be properly cleansed.

When the elevation of the kitchen is so low that the flue cannot be gathered over upon each side, a piece of stone, or slate, or some other substance should be placed on the opposite side to the gathering wing, so as to cause the air to enter the flue as near the centre as possible ; or if that cannot be done, the grate should be so constructed that the fire part be as much as possible under the commencement of the flue. And this is necessary for two reasons : first, that, as the air will enter the fire-place with more rapidity at that part of the chimney-breast which is immediately under where the upright shaft starts from, it should be brought as much as possible in contact with the fire, to be heated, and thereby receive its ascending power ; secondly, that, as the air proceeds more rapidly at that point, it should be brought in contact with the smoke, so as to carry off the heavy particles emitted from the coal. With regard to chamber-flues where register stoves are to be fixed, it is not important to attend to this rule, as the register door forms a central opening for the air and smoke, whether the flue be gathered over upon one side or both.

In small fire-places with short shafts, I would not gather them over at all, till compelled to do so, but would leave all the size I could, to give extra power to the chimney (Case 25).

CHAPTER XII.

Description of various Patent Stoves, Furnaces, &c., with Observations upon the Consumption of Smoke and Coal.

MANY attempts have been made, with more or less success, to consume the smoke from coal fires. The best house grate that I ever saw for that purpose, as also for the more perfect combustion of the coal, was patented by a London ironmonger, about 1813. It was so constructed that when the bottom (which was a plain plate instead of a grating, and which was made to rise and fall by means of a spindle and two chains) was lowered, it formed a box capable of containing a supply of coal for twenty-four hours, or more; and the fire being lighted upon the top of the coal, the heat caused it to emit the gas and supply the fire above it, as oil would a lamp, thus the gas having to pass the fire previous to its ascend-

ing the chimney the major part of it was consumed, and very little smoke could pass up the chimney; the reader will be aware, however, that this action of the heat on the coal, even before the latter was seen to burn, must have deprived it of its gas, and consequently have converted it to coke, which always produces a fire nearly free from flame; therefore, in order to obtain a bright and cheerful fire, it was essential that the opening for the air and what little smoke escaped, should be at the back of the stove immediately above the top of the fire; for as there could be no passage through the bottom for the air, it was necessary that it should act rather powerfully on the front; this situation of the opening had the effect of driving the heat so much towards the back of the fire-grate that the same was composed of fire-bricks, iron would have been liable to melt, or to burn through. The appearance of this fire was not very pleasing, for when the same was moderately brisk the coke against the back was very lively, and that in front rather dull, at least in comparison with the other; and when it was drawing powerfully, the cheerful and bright fire in front was accompanied with a perfect furnace towards the fire-bricks. Perhaps *my* eyes were somewhat more offended at this than those of other persons, as about the time

these stoves came into use, I had invented a Range so constructed that a perfectly contrary effect was produced. This is usually denominated the Back Boiler Range; for the boiler of it being in the shape of the letter L, forms the *back* and side, and, in some cases, the back and both sides of the fire of the range, and I was for some time continually attracting the public attention to the fact, which was then rather new, or, as I should with more propriety say, which was but just received, that water at the back part of a fire prevents the coal from burning in that part, so fast as in the front, or as in a grate that has not water behind it. By this improvement, I was producing hot, or boiling water, and consequently *steam for cooking* at a diminution of expense; which will, I think, be credited when I affirm that upon very many occasions I have seen the remains of a fire, which had roasted one joint, steamed another, besides vegetables, puddings, &c., but which had not been disturbed to make vessels boil upon the top; the coals in front having been nearly all consumed, while those at the back had formed a thick mass of coal and coke adhering to the boiler, and which, if removed, would nearly fill the grate, and be found sufficient fuel for ordinary purposes.

Had not water been at the back of the fire, the coal, instead of caking together would have been consumed. For heating water in a back boiler *coke* fires are much the better, as they cannot form a solid mass.

I was desirous to obtain further information respecting the Patent Stove, of which I have been speaking, and accordingly went to my friend (if he will allow me to call him so, after having now been on amicable terms for forty years) to ask him if it was possible a fire could be used with economy in such a grate, which, when burning well, was half of it like a furnace. He replied, that it could; and gave the following explanation: that a large portion of the heat was occasioned by gas, which, in a common stove, would go up the chimney; this I readily acknowledged; for, when we consider the quantity of inflammable matter which accumulates in a flue, and which is only a very small part compared with what passes off at top and impregnates the air, we must be sure that the loss of fuel is immense, while the combustion of the Patent Stove was so perfect, that its chimney did not even require sweeping.

Another convenience in this stove was, that by lowering the fire to the level of the bottom bar, the air did not have much effect upon it; so that, while

the room was out of use, or during the night, the gas would gently continue burning with very little consumption of fuel; and, again, by raising the bottom of the stove with the winder used for that purpose, a good fire was quickly obtained; but unless care was taken to stir the coke and coal antecedent to their being wound up, it would be very difficult to raise the iron bottom with the fuel, the coal having much swelled.

The London ironmongers were so much alarmed lest all the business of stove making should be directed into one channel, that numerous attempts were made to evade the patent, by placing the coal *behind* the fire, to be drawn forward as required: but neither this, nor other contrivances which were brought before my notice, answered so well as the Patent Stove which I have endeavoured to describe as particularly and impartially as my knowledge of the subject would permit.

After a while the trade entered into a subscription (which I, who always sincerely wish that every inventor may reap the full fruit of his invention, refused to join), to commence an action at law in the hope of upsetting the patent on the alleged ground that the invention was not new: and with a little manœuvring and management they persuaded the jury that it

was precisely the same in principle as a cooking apparatus which was then in use, the fire of which could be, by a rack and pinion, below the fire, readily elevated to the top of the apparatus, so that a small fire might act upon the upper part of the oven, which had a flue over it, and then pass down the contrary side: but though the action of raising the fire might appear similar, the application was wholly for a different object, and very differently arranged; the one having a solid bottom, which was not raised above the level of the lowest bar in front, but descended nearly to the hearth to receive a quantity of coals for the purpose of supplying the fire and consuming the gas, the raising being performed by means of a spindle with chains from the top of the stove to the solid iron bottom, while the other was an open bottom which never descended below the fire-bars in front.

I used one of these stoves in my bedroom about ten years since, and found it exceedingly convenient for keeping a fire all night.

I have seen the same principle tried in a common stove.

Mr. Aitkin, who was secretary to the Society of Arts, used to have the grate in his sitting-room filled with small damp coal, and the fire made at the top;

for the purposes of economy, consuming the gas, and requiring less attention. Mr. Aitkin stated that by the fire being lighted at the top, and no draught through the bottom of the grate (by consequence of its being closely filled with fuel), the coals smouldered, without much consumption, and kept burning with scarcely any attention. He says he had a fire to breakfast by, and if he required to use the room during the forenoon, he raised the upper part of the coals a little with the poker, as also at dinner-time, &c.; towards evening the lower part became ignited, no more coals were required, and the remaining cinders were next morning used to make the fire at the top of the coals. I have tried the same in a common stove, but do not find it a cheerful fire, that one would like to sit by for any time, though it might answer in a room partially used; and when the mass of coal at bottom is disturbed, and the air gets through the grating, the coal burns with great rapidity.

The greatest heat to be obtained from coal is, I consider, by supplying the fire with a *small* quantity at a time: when the fire is good it ignites immediately, and the gas produces flame and heat. When a *large* quantity of coal is put upon a fire, a dense smoke follows for a considerable time almost without flame, thereby losing a large quantity of gas, and conse-

quently the heat which would have been emitted had combustion taken place.

I have seen a small quantity of coal spread over the top of a strong fire about every half-hour for the purpose of economising heat, but this is a trouble and loss of time of which few people would approve. I have found that the greatest economy of coal and time in using a common fire-grate, is to have the grate rather large for the size of the room where it is to be used, and the bottom of the grate to be *partly* solid iron, instead of an entirely open grating. All stoves should be made with two, three, or five inches plain at the back edge of the bottom, according to the size of the fire to be used: I would take as a minimum about half the breadth, and in large fires rather more than half; the fire will then be found to burn well, but not to excess, and what is perhaps of more importance to professional gentlemen in the office, and to persons who have occasion to leave the drawing room or other apartments for a while, they will find that if the servant is not continually in attendance, the fire goes out; but by adapting a large fire-grate with part of the bottom solid iron, or covered over with a piece of iron plate, or otherwise, the fire will keep burning for some time without any attention. A few years since, I was accused, by a lady residing

near Hyde Park, with having made a mistake as to the effect to be produced by such an alteration made to two stoves, having promised a saving of one scuttle of coal out of four : the result being three out of five ! The lady might have been right, and my calculation wrong, but I never promise so large a result, and think, upon an average, that a stove adjusted upon the above principle, may be the means of saving from twenty to twenty-five per cent. in the consumption of fuel, and that it will require much less attention.

Persons who have their grates reduced in size by what is termed a "false bottom," with the avowed intention of saving fuel, make a great mistake ; as, from my own observation, I am satisfied that, on the contrary, an increase in the average consumption of from ten to fifteen per cent. takes place. When people, from conviction, even admit the truth of this, they sometimes say, "It makes a brighter fire." This is true ; and if they choose to burn more fuel than is necessary, and can afford the time to attend to the fire, or to have it lighted if it goes out, of course they must be at perfect liberty to do as they like with their own ; but, beyond this, there is a disposition in some persons not to put away anything which has cost money, and to go on in error rather than to sacrifice the cost-price of the article. There are,

however, I am happy to say, many exceptions to this rule, of which the following is one:—About thirty-five years since, a very respectable London tradesman, who had built a house for his own residence in Highbury Park, and had erected a close cooking apparatus for the kitchen, and had one of my open ranges (about the fourth I had made) fixed in the house of business in Little James-street, said that the apparatus at Highbury cost nearly fifty pounds, and that the consumption of coal was so considerable, that the sooner he exchanged it the better, as he could never make up the loss by continuing to use it.

Further, those who expect economy from reducing the size of the fire by cheeks, *unless the grate be exceedingly large*, make also a mistake; for, if the grate be so reduced in size that the fire will not burn moderately free, the poker is constantly at work, extra coal is *destroyed*, and personal comfort is certainly likewise destroyed, without any adequate saving. I often tell my friends, who, I consider, have mistaken notions of economising fuel, that, while they might have the pleasure of *seeing* the coal burn, they are continually destroying it with the poker.

Many inventors have applied to me with different plans to consume the smoke, but I have not seen any

for house-fires equal to the one described at the beginning of this chapter. One man had actually taken out a patent, after which he called upon me, and requested that I would see the specification and drawings which he had enrolled. I told him that the plan was very inferior to that which had been tried upwards of twenty years before. He abandoned the attempt of bringing it before the public, but turned his attention to the supplying of coal to furnaces upon the same principle, which was, the having a part of the bottom of the furnace *without bars*, that the fuel could be supplied from below through the opening thus made; and when the coal had become coke, to be raised, by means of a lever, into the fire, as in the case of the house-stove for consuming smoke already described and referred to. But all this was found exceedingly difficult to manage, and very inefficient; the patentee then adopted a plan of having the coal supplied from above on to revolving furnace-bars or endless chain, the width of the furnace, and made in short lengths of flat iron, about half an inch thick, put together like the bars, or "chains," as they are called, that support suspension-bridges; and so, there being always one bar between two others, an opening of half an inch between each was left, to supply the air to the furnace. On to

these furnace-bars, or endless chain (which slowly revolved by means of rollers worked by the engine) was made to fall the necessary supply of small-coal, *outside* the furnace-door, or plate, which was made to rise and fall, and could be so set as to regulate the quantity of fuel admitted to the furnace, perhaps to the thickness of an inch, or more or less, as might be necessary. The coal on arriving inside the plate or doorway of the furnace, becomes heated, and begins to emit the gas which of necessity becomes flame in passing over the strong coke fire, in its progress to the flue. When the coal arrives at the middle of the furnace, it has nearly parted with the gas, and become coke; and when it has gone the whole length of the furnace, it has become exhausted, and the bars, in turning over the roller, throw off the clinkers, &c., and becoming cool, return to the other end for a fresh supply of coal.

I believe this apparatus answers very well, and is very economical in practice. I am informed from a friend, who has two in use, that the small coal is purchased at about forty per cent. below the usual price of coal for furnaces, and that, by consuming the smoke, nearly fifty per cent. upon the small coal is saved.

I have been told of a steam-engine boiler having

the furnace (intended to consume its own smoke) so constructed that the coal was supplied at a number of small holes on each side of the same, and a boy in attendance to press a little coal through each opening in rotation, and always leaving some coal in the apertures, to keep the air from entering by them; by this means, the supply of fuel was so little at one time, that the smoke was nearly all consumed.

Another plan was, I believe, patented by a Captain Hubbard, and used at a steam-engine at Shadwell. The coal was supplied upon a round table, or plate, revolving horizontally within the furnace, so that, by the centrifugal force, the coal was distributed over the surface of the fire in a thin layer, and the gas very much consumed.

Another plan for abating the nuisance of smoke from large fires, adopted in an extensive brewery in Tottenham Court-road, consisted in the use of a peculiar combination of coal. I believe the proportions were as follows: three parts anthracite coal, two parts culm or small coal of the same, and one part bituminous coal; the bituminous coal to assist the combustion, and the anthracite coal, from its excessive heat, to consume the smoke from it. I have often remarked, in passing the brewhouse, how very little smoke escapes from any of the chimneys.

An open grate, intended to give a large quantity of heat in proportion to the coal consumed, was patented by me many years since. The fire was wholly projecting from the "front," and so constructed as to rise and fall at pleasure, in order that it might be brought more or less in contact with the air which entered the chimney, together with the smoke, by a small aperture (about four inches by nine) in the upper part of the front, with a small hood or canopy over it, and therefore under which the smoke passed. This canopy over the projecting fire becoming heated, diffused much heat to the room; and the fire presenting three sides to the room, threw out also much heat; and from the smallness of the opening to the chimney, but little warm air escaped up with the smoke. The "back" of the stove being nearly as forward as the face of the chimney-breast, there was a considerable hollow left behind it, the air in which becoming rarefied, assisted the action of the flue.

A number of scientific gentlemen came to inspect my grate (and also my "Patent Revolving Float," the *centrifugal force* of which caused warm water to descend, and the cold to rise; by which one of the well-known laws of gravity was reversed, or rather overruled by a strong antagonistic force, and

which was applicable to the warming of buildings from a fire situated *above* the place to be warmed), among whom I had the honour to receive the late Sir I. Brunel, Dr. Lardner, Professor Moseley, Horsman Solly, Esq., Arthur Aitkin, Esq., from the Society of Arts, &c. One of them expressed an opinion that it would be very likely to smoke, from the open sides above the fire, and immediately tried its power by wafting the flap of his coat so as to act upon the smoke above the fire-bars and below the canopy, but without effect.

A gentlemen in the Isle of Wight, to whom I had supplied one, wrote me saying, that the Patent Stove was a perfect cure for his smoky chimney, though I did not profess that it contained that quality. Others wrote me, that from the projecting fire and heat radiated from the canopy, the effect of having a second stove was equalled. Also from the small opening of the chimney and the less escape of air at that point, less cold air rushed in at the door and other crevices of the room. One of these grates may be seen in use in the coffee-room at the Albion Tavern, Vernon-place, Bloomsbury-square. The landlord pronounces it the best piece of furniture in the house ; but they must have had some fault, or certainly they would have been more in use. I consider the chief

defects to lie in their permitting much dust to fly into the room, which in ordinary stoves, would go up the chimney ; and also in their being rather expensive : but I think they may be used with great advantage in coffee, committee, and other public rooms.

CHAPTER XIII.

A few Remarks on Ventilation.

WHEN we compare the construction and fittings of houses of the present with past centuries, it can be no matter of surprise that ventilation was formerly less studied than the present state of things renders it necessary that it should be.

When the major part of our rooms were lined with wainscot, and when, through the large cupboards and wooden cornices, there were sufficient openings and crevices to supply the air for the support of combustion and other necessary purposes; and when, added to this, most rooms had a large fire-place permitting the escape of much air up the chimney, apartments were in general tolerably well ventilated. But different to this has become the case of late years; when many of our floors have been built fire-

proof, and with what is termed sound boarding, the walls and cornices of plaister or stucco, and in many cases the skirting of compo. ; when some doors are supplied with a nicely arranged slip, to rise over the carpet, and fall again when the door is shut, the key-hole having also a little shutter to perfect the closing of the apertures ; when the hole formerly used for the bell-wires, leading to the staircase or hall, is, by the present system of bell-hanging, dispensed with ; and when if after that our best friend, the air (which some seem to think an enemy), should make a little extra exertion to supply a strong fire, and make a small entry between the well-fitted sashes, a sand-bag is introduced to prevent the intrusion, then persons occupying such close boxes, are not only much surprised that they have not good health, after so much pains has been taken for their comfort, but that the chimney will not perform its office, howsoever well constructed ; and upon one occasion, when I was suggesting to a lady how unreasonable it was to expect a chimney to act properly under such circumstances, she ridiculed my remarks, and said, I must be in error, as the great aim of architects of the present day was to make rooms air-tight ! In fact, so far as my observation has gone during the last forty years, I should say that, whatever attention has

been paid to ventilation has been confined to public buildings and lodging-houses for the working classes ; but I am decidedly of opinion that every mansion and dwelling-house should be so constructed, as to afford to every apartment, means for ingress as well as egress of air, and the consideration should be as to the best and the least inconvenient point for the same.

The first ventilator I remember to have seen fixed, was the well known circular one, made of tin, with many cuts or slits from the outer edge to near the centre, and twisted a little, similar to the sails of a windmill, or the fly of a smoke-jack, the air acting upon which in its passage through the openings, causing it to revolve with considerable velocity.

These ventilators have been much introduced to ventilate smoke rooms and manufactories (where the articles manufactured have caused an unpleasant or oppressive sensation), and were usually placed in the upper part of a window, or over a door leading to a cool passage ; but if any one would consider for a moment, they would be convinced that the desired effect could not be produced ; for, whereas it was intended that the smoke or unpleasant vapours should be taken off from the room or factory, exactly the reverse would ensue ; for the air outside the window,

or in the cool passage, being of more specific gravity than that in the apartment or factory, there would be a rush of cold external air into the apartment, leaving the smoke and unpleasant vapours to make what escape they could, by the flue or some other convenient point; while the persons occupying the room, would be subjected to a strong current of air passing the head or upper parts of the body. This ventilator is mentioned in a book I have already quoted, published in the year 1776.

Several attempts have been made of late years to ventilate rooms, evidently with the intention of letting air into the same, therefore, the persons using them could not be disappointed as to the intention of the designer, though the result might be inconveniently felt upon the upper parts of the body, as with the rotary ventilator above mentioned; and, as I cannot understand that there is much difference in effect, whether air be admitted through an opening with or without the revolving wheel; I think the chance of the noise these wheels frequently make, may well cause them to be dispensed with.

The "attempts" I allude to are, the perforating of the glass at the upper part of the sash, or the introduction of glass plates as louvre boards, and others, such as the making of an opening through the brick-

wall, and a plate introduced, so constructed that the air, upon entering, should strike first upon the ceiling, in order that it may travel a distance before it descends in the room. But this contrivance is not new; for in a letter written by Dr. R. Franklin to Dr. Ingenhauz, physician to the emperor at Vienna, dated at sea, 1785, after stating the necessity that exists for admitting air into a room to support combustion, and in what manner the same may be admitted, is added "Another way, and not a very difficult one, is to take a pane of glass in one of your sashes, set it in a tin frame, giving it two springing angular sides, and then replacing it, with hinges below, on which it may be turned to open more or less above. It will then have the appearance of an internal skylight. By drawing this pane in more or less, you may admit what air you find necessary. Its position will naturally throw that air up and along the ceiling. This is what is called in France a *Was ist das?* As this is a German question, the invention is probably of that nation." Which I also think very likely; as, in a similar way arose, amongst others, the word Haberdasher (*Habedas, Sir*) first applied to those who brought German wares to this country for sale.

I am decidedly of opinion that the proper method to ventilate buildings or apartments is, to *admit* air

at the *lower* part of the same, and to have the *outlet* in the *upper* part.

I have been much surprised to see in many feeble flues, and often in suites of rooms very inefficiently supplied with air, so much so that, in consequence, the flues did not well perform their office, that a hole had been made, or a ventilator placed, near the top of the room communicating with such chimneys (evidently to the detriment of the smoke being carried off at the fire-place; as, I have frequently urged, any hole in a chimney will reduce its power) while there was no provision made for the *ingress* of air to the apartment, though there were two, the fire-place and the ventilator, for *egress*, besides a large quantity being required for combustion.

I cannot for a moment suppose that so eminent and talented a man, and one who has rendered so much service to mankind, ever intended that beautifully constructed ventilator which bears the name of Arnott to be placed in a *feeble flue, without any provision being made for the supply of air*; as a slight disarrangement of it would be liable to admit smoke into the room; or, if acting properly, would take so much air out of the room, and so cool the flue by the opening made into it, as to impede the progress of the smoke at the fire-place, that, in many cases, I have

known them to be removed or securely closed, to prevent their action ; and I must say I do not recollect any advice being given for the *admittance* of air into the apartments where these ventilators were to be fixed.

The Great Globe, or Model of the Earth, in Leicester-square, was provided with holes, about one foot square, near the bottom, for admission of air, and with louvre boards at the top, intended for the outlet ; at a distance from the louvre boards a brick wall was erected, that the air should escape at the top, similar to smoke at the top of a chimney. I was informed that the wall was built with the view to produce an upward current of air, and thereby to assist the ventilation ; but whether it was for that purpose, or for the appearance of the building itself, and to keep the louvre boards out of view I do not know, but when the gas was burning and persons assembled, the ventilation was not sufficient. The Archimedes' screw was recommended, and several were placed upon the top : I should presume that, from the heat produced by the gas, and otherwise, they would work with considerable velocity, and take out a large quantity of air ; but the ventilation was still imperfect, and the openings at the bottom were enlarged from one foot square to four feet square each, or to sixteen

times their former size. By this greater admission of fresh air, more warm air within the building would be displaced, and consequently more would pass off through the apertures at the top.

The Archimedes' screw will certainly exhaust a room, *while it continues to turn the right way*. I had one placed upon the top of a chimney nearly twenty years since: it was made by a trunk-maker at the west-end of London, and recommended to me as a cure for a smoky chimney, and certainly the moment it was fixed the screw commenced to turn, from the slight current produced by the warmth of the chimney, though there was not any fire in the grate at the time: but as it turned upon a centre with much freedom, I was quite satisfied that, when the chimney became colder than the room, the current would be downwards, and the Archimedes' screw would turn the contrary way, and allow the smoke of the *adjoining* flues to come down just as freely as if the screw were not there; consequently, an Archimedes' screw can ventilate a room or building, only so long as it turns the right way for that purpose.

An Archimedes' screw was produced a few years since, and, I believe patented, with fans or vanes at the top, and open metal work, similar to louver boards, placed horizontally, which had the effect of keeping

the screw in motion the right way, when there was wind sufficient for the purpose. I have seen a horizontal windmill with perpendicular louvre boards upon the Surrey bank of the Thames, near Battersea, worked upon the same principle.

Another system of ventilation, by means of what is called a ventilating stove, has lately been announced. This stove is so arranged that the air is taken from near the top of the room, through a pipe, and discharged into the flue; but, as there is not any provision made for the supply of air, it must very much exhaust the room, and cause the chimney to be *disposed* to smoke; however, in order to prevent the smoking, the stoves are made with small openings above the fire-bars. The patentee says "the bars should not project before the opening of the fire-place, and the said openings should be less than the sectional diameter of the chimney." By which means it is well known, that a very powerful draught can be created; and as flues are usually built fourteen inches by nine, this arrangement would bring the current of air so near the fire as to cause a considerable consumption of fuel, and the air would be so highly rarefied as to rise with great velocity in the chimney, and cause other air to enter the room with increased pressure through the crevices and under the door, &c.,

to the annoyance of persons using the same; and few Englishmen would like to see a large stove in a handsome room with the fire part so much like a furnace; and it would be very inconvenient for a nursery, or for the humble classes, who have some little matters to do on the top of the fire.

I consider that, upon a general review of the matter, a system of ventilation for general purposes is still wanting, as well as for correcting flues from smoke.

I have been asked by architects as to the propriety of drawing the air from the top of a room, and passing it up the chimney, by means of an inverted syphon; but I have always been unwilling to adopt it, knowing it would be opposed to the proper action of the chimney.*

I have fixed an upright pipe to take the air from the upper part of a large school room, the lower end of the pipe with an elbow, to convey the air passing down the pipe to the under part of the bottom bars of the grate, and by closing the "front" below the bars the *air from the top of the room* supplied air necessary for combustion, to the bottom of the fire, and *this*

* Since writing the above, I have been informed that Dr. Chowne has taken out a patent for ventilation upon this principle.

did not exhaust the room more than it was exhausted before; for if the air had not been taken from the top of the room it would have been supplied from the bottom. I allow that melters' furnaces are sometimes set upon this principle. The air to supply combustion in the furnace passes over the top of the pan, and carries with it the effluvium and steam arising from the contents of the pan; but it has always appeared to me a dangerous position for a man to be working at the contents of a hot melting pan, with a strong current of air to create ventilation passing his body.

Many close cooking grates have also been fitted with pipes to supply air to the fire, which pipes being provided with fans or vanes, have been useful for putting a joint of meat in motion, while being roasted in a screen or otherwise.

I have often thought it practicable to have a long air-drain formed to supply a large furnace with air, and fitted with flies or Archimedes' screw, by which a motion might be obtained, suitable for the raising of water, or many other useful purposes.

Many years back, I believe about the year 1810, a system of ventilation was introduced to the public by a gentleman, I think his name was Deacon, having an office in Red Lion-square. The means employed was a large fan, acting similar to the opening and

shutting of a door, by which the fresh air was drawn through glazed earthen pipes, which conveyed it to gauze, or other light material, placed before the cornice of the room, or to bags behind the window curtains; and so arranged that in cold weather it was capable of supplying warm air heated by water. I think it was tried in the Old Bailey Court, but with what success I do not know. I was told that the waving of the fine cloth, through which the air passed, was offensive to the eyes; and as this system soon went the way of all the Capulets, I presume that it was rather inelegant or inefficient.

Dr. Reid's plan for warming and ventilating is the contrary of the above; as by means of a ventilating shaft heated by fire, the air is drawn from the top of the apartment, consequently either cold or heated air will immediately supply its place at the openings *prepared for that purpose* at the bottom. I believe that air can be supplied to the present House of Commons, in any required quantity, to the extent of fifty thousand cubic feet per minute.

The two last-mentioned systems of ventilation are only suitable to public buildings, or large establishments, where the expense of keeping a fire, or employing a man to work the fans is not important; so likewise is the following, and which I was surprised

to see, from its novelty to me at least, and also from its deviation from the usual practice, but which may be advisable under peculiar circumstances.

In the rooms of a prison, the warm air is made to enter at the top and pass off at a lower point in the apartment; the reason for this being that the unfortunate occupants, for the want of employment, might be disposed to crouch down to the aperture for warmth, if within their reach.

I could give many other plans for ventilating houses or rooms, but those quoted, with a few practical experiments which I shall now attempt to describe, will, I hope, be considered sufficient for a work not professedly upon ventilation, though this subject is so closely connected with the theory of chimneys, that it is hardly possible to treat upon one without mentioning the other.

PRACTICAL EXPERIMENTS IN VENTILATION.

Case 53. In the Hall of a City Company near Distaff-lane, a kitchen door was only a few steps down below the entrance hall, having several steps inside the kitchen, and consequently the doorway was nearly close to the ceiling, so that the heat and smell occasioned by the process of cooking, had a very

ready escape to the different parts of the house, so much so, as I was informed, that the principal rooms were frequently rendered very unpleasant by its effect. I was requested to correct the evil, which I did by placing a large ventilator in a flue, from a hot plate, close under the ceiling of the kitchen; the hot-plate fire being a close furnace, could well afford to have the opening for the ventilator made into it, and from the very high temperature of the air in the flue, the air from the kitchen pressed forward with considerable velocity; and by keeping all the *windows* shut, so large a quantity of air entered at the kitchen doorway to supply the combustion of the several fires, and also the different flues and the ventilator, that not any effect of the cooking passed up the staircase. I attended with the officers of the company when the first large dinner, after the alteration, was being prepared, and though we could, from the kitchen door, see the process of cooking, we could not discover any smell from it.

Case 54. The following case of ventilation was adopted by me about 1825. A waiting room for sick persons at a workhouse, in Gray's Inn-lane, was heated by a hot-air stove placed in the room. I directed a cold-air drain to be constructed, to supply fresh air from the outside of the building to the air-

chamber of the stove; therefore, while fresh heated air was supplied to the room, the vitiated air was supplying combustion, and passing off through the flue; and though it appears in most cases preferable to take the heated air from a building at the upper part of the same, the above arrangement answered very well; for the fresh air entering the room in a rarefied state, would ascend to the upper part of it, while the air from the lungs would, when condensed, fall to the lower part of the room and pass off to the fire.

Case 55. I directed a similar case to the above, with good effect, at the Office of Works, City. The office had been for several years occasionally very unpleasant, from the flue of the descending stove being rather imperfect, and from the high temperature of the air from the stove, without any regular supply of fresh air to the same; but by correcting the flue, in addition to forming a cold-air drain to supply the hot-air chamber of the stove, the office is very agreeably heated and ventilated.

A room may be ventilated, to a certain extent, without the aid of machinery or fire heat, by making two openings in the ceiling; the pipe from one opening to be carried up above the roof of the building, and the pipe from the other to be taken down to the

open air to near the bottom of the building. The air near the surface of the earth being of more specific gravity than that above the top of the building, will enter the lower orifice of the pipe and pass up to the room, while the air from the room will pass off at the orifice of the upper pipe, where the air is lighter, and consequently presses with less force than the more weighty air at the lower pipe. This is chiefly available in the summer time, when fires are not in use; for were a strong fire in the apartment so ventilated, the air would probably enter at both pipes, to supply combustion, unless there was otherwise a good supply of air.

The "windguards" (mentioned in Cause 3) are also styled, and recommended as, ventilators. I have attended lectures upon this subject. I have seen experiments made upon the lecture table with the model of a house, of which one of the rooms was filled with smoke, and a windguard fixed at the top of the chimney, to this the common bellows was applied, and certainly the smoke did ascend; but I cannot find it so in *practice* upon the house top, and I have known very many of these windguards to be removed as inefficient, the reason of which I can only suppose to be that the *wind* acts less powerfully upon the windguard on the house top, than did the bellows upon the model.

The foregoing pages have run to a greater length than I at first contemplated.

I may have been considered tedious in many of my remarks, and perhaps the cases cited have appeared more than necessary to illustrate my meaning and to convey what information I hoped to impart; but though there is a considerable degree of sameness throughout, my anxiety to make the subject clear to the operative, more than to the scientific man, must be my excuse.

Should some of my readers think that I have omitted any material point likely to be met with, or that I have improperly described any of the *causes* or *remedies*, I shall be glad to receive communications. So also shall I be most happy to give any information or explanation respecting any part of the subject in which I may not have been clearly understood.

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A P P E N D I X .

Coppers, Baths, Flues, &c.

MANY subjects crowd upon my mind, connected with our domestic comforts, and though they may be either of little importance, or not immediately upon the subject of building chimneys, they are some of them so closely allied to it, that I may be excused for giving a few general remarks, supposing that any suggestions or improvements which tend to comfort or economy will be acceptable.

I have for many years observed an error which most operators fall into in the usual practice of setting coppers for domestic uses, and also small steam boilers, in leaving too much of the surface for the action of the fire, by reason of which they are destroyed in less time than they otherwise would be. In nine out of ten of the common coppers I have seen taken down for repairs, or to be replaced by new ones, the parts

most deteriorated have been four to ten inches down from the top, and that part of the circle over where the fire rose from the furnace, and the *cause* will appear perfectly clear by a little consideration upon the subject.

The usual practice, as just said, is to leave as much surface as possible for exposure to the heat or flame, for which purpose the entire outside of the copper, from the bottom to within two or three inches of the rim or flange at top, is left about four inches clear of brickwork, except where what is termed the stop at the back is placed; and the consequence is, that the flame, after acting partially upon the surface of the bottom, passes through the opening (probably about ten inches by four), at the back part of the furnace, and enters a space (perhaps sixteen inches by four), at the side of the copper, and thus the flame, which is continually reducing as it proceeds, cannot possibly fill the large opening, but will rise to the top of the same, and pass round it at *that* part of the copper, leaving the lower part of the side of the copper without any flame, and with very little heat acting upon it, and as coppers for washing and other domestic purposes are frequently used only half-full of water, or sometimes less, but usually about two-thirds full, the fire operates the strongest at that part which is

without water, and consequently the copper is destroyed near the top, and generally also at that part where the fire first rises from the furnace, to prevent which, and at the same time to obtain as much or more heat, I recommend that the coppers, instead of being safed in, as it is called, with one brick laid flat, or sometimes with a paving brick which is thinner, and at other times with two courses of plain tiles, should be safed in with two or three courses of bricks, according to the depth, which will add much to the strength of the brickwork, and keep the flame and strong heat near the bottom, where there is certain to be some fluid to be heated ; this will, too, have a much better effect, as frequently much of the heat is lost by its passing round above the level of the fluid, and, as has been observed, destroying the copper ; but, should even the copper be full, the result produced by the old way of safing in will not be so good, as heat in water or other liquids does not readily *descend*.

I do not at all allude to large coppers for brewing, &c., which are usually set by experienced workmen, who are continually at such work, and who, I presume, do it in a very efficient manner.

Coppers or small steam-boilers, of about thirty gallons or more, may be very advantageously set by causing the flue to turn both right and left from the

opening at the back of the furnace, by building a horizontal wyth, about one-third the distance up from the bottom, with one course of bricks flat all round the copper, except about six inches in the front over the fire door, where the flame will meet and turn back again right and left under the safing at the top till it arrives at the upright flue, this will be equal to taking the flue twice round the copper, and be much less trouble, and by a soot door, or stone plug, or a brick lightly fixed so as to be readily removed, in front opposite to where there is not any wyth, the four compartments of the flue which are above and below the wyth on each side can be readily cleansed with a brush: it will also be a farther economy of heat if, under such copper, a small opening is made two inches square or three inches by two under the copper, upon each side into the lower part of the horizontal flue, as part of the flame from the furnace will make its way right and left into those openings, and cause the flame to spread more under the surface of the bottom of the copper.

I have caused coppers and steam-boilers to be set upon the above principle with very good effect, especially for steaming food for cattle, at Mr. Mechi's model farm in Essex, Lord Rokeby's in Hertfordshire, and many other places.

I have also applied the same principle to round boilers for the circulation of water, and though I do not wish to touch upon the circulation of water for warming buildings, the subject having been ably treated by Mr. Hood, in his work upon warming by hot water, and others, I think it will be advisable to describe one case where a boiler has been set under my direction, for the purpose of supplying hot water (only), to various parts of a building, with considerable economy in the erection of the apparatus, and also of fuel in the working of the same, and which I hope to make appear very clear.

At the King's College Hospital, hot water was required to make baths, upon each floor of the building, as well as for other purposes, to meet which requirements I supplied a circular iron boiler, in the basement, with pipes for circulation to the upper parts of the building, which boiler and pipes being always charged with water, would not be liable to rust inside, and the upper ends of the ascending and descending pipes were carried into a copper cistern (tinned inside so as to be free from rust), capable of containing about forty gallons, and the supply to which was from the main cistern, by means of a ball-cock and regulating cistern. Instead of drawing the hot water from the copper cistern at top (which

is I believe the usual practice), by pipes down from the same to the different parts of the building, I placed a cock upon each floor in the *ascending* pipe, and thus obtained the water at the highest temperature as it came up from the boiler ; for the water in the copper cistern would not descend *that pipe even while the bath was making*, but would go down the descending pipe and pass through the boiler, having the fire in the furnace heating it in its passage. If the water had been drawn from the copper cistern at the top much heat would have been lost by the action of the air upon the pipes ; and the water contained in the pipes between the cistern and the cocks would, after each time the water was drawn, become cold before more was wanted, and would have to be drawn off before the hot water could flow, thereby causing much loss of water as well as heat. By the above arrangement, the cost of the apparatus was much less than it otherwise would have been, and also a considerable saving of fuel was ensured.

I have seen coppers set to supply baths with hot water, sometimes the copper being in the same room as the bath, and at others in an adjoining room upon the same floor, arranged so high that the water could flow direct from the copper to the bath, as liquor in a brewing copper does to the mash tun, but by this

means the coppers have been rendered inconveniently high for any other purposes, and have also required an extra quantity of brickwork to be erected, *and unless the fire was allowed to be nearly exhausted before making the baths, the copper would be liable to injury, by all the water being drawn off*; to obviate which I recommend that the copper should be set a convenient height, sufficient to leave room for the furnace, and the top of the copper being higher than the top of the bath, the water to run from near the top of the copper at an opening made for that purpose having a pipe attached to convey it to the bath: the supply of cold water to the copper to enter near the bottom of the same. While the bath is making, a strong fire can be kept in the furnace, that more water may continue to be heated, and so render a less copper sufficient, while it will also furnish further supplies of hot water should any be required, and by reason of the copper never being exhausted, it will be much less deteriorated by the action of the fire upon it.

I have fixed close boilers to stoves in bath-rooms to act upon this principle with very good effect, and by fixing a pipe for the steam to ascend the chimney if any should be generated, the fire may be kept in use to dress by, or for any other purpose, providing the boiler is not allowed to become dry, and which can

always be prevented by turning the supply of cold water to it.

Since writing chapter xii., upon the consumption of coal and smoke, I have seen a stove, which I believe is patented, intended to economise fuel, and consume the smoke in common fire-grates. The plan is, to supply the coal at the bottom of the fire instead of the top, for which purpose the patentee proposes that the burning fuel should be raised from the bottom with an instrument like a flat shovel or a peel, while a part of the lower bar in the front of the stove is to be drawn forward, and is so contrived as readily to open with a joint, and the coal is supplied upon the bottom grating, while the fire is borne up by the "instrument," above named: the fresh coal is ignited by the burning fuel contained in the upper part of the grate, and so a large portion of the smoke or gas emitted must be consumed, by having to pass the fire in its way to the chimney. Howsoever praiseworthy it may be to make attempts towards the accomplishment of objects so much desired as the economising of fuel and the consumption of smoke, I much fear that in the case I have just instanced the stove will be capable of such a limited supply of coal at a time, as to be troublesome in practice.

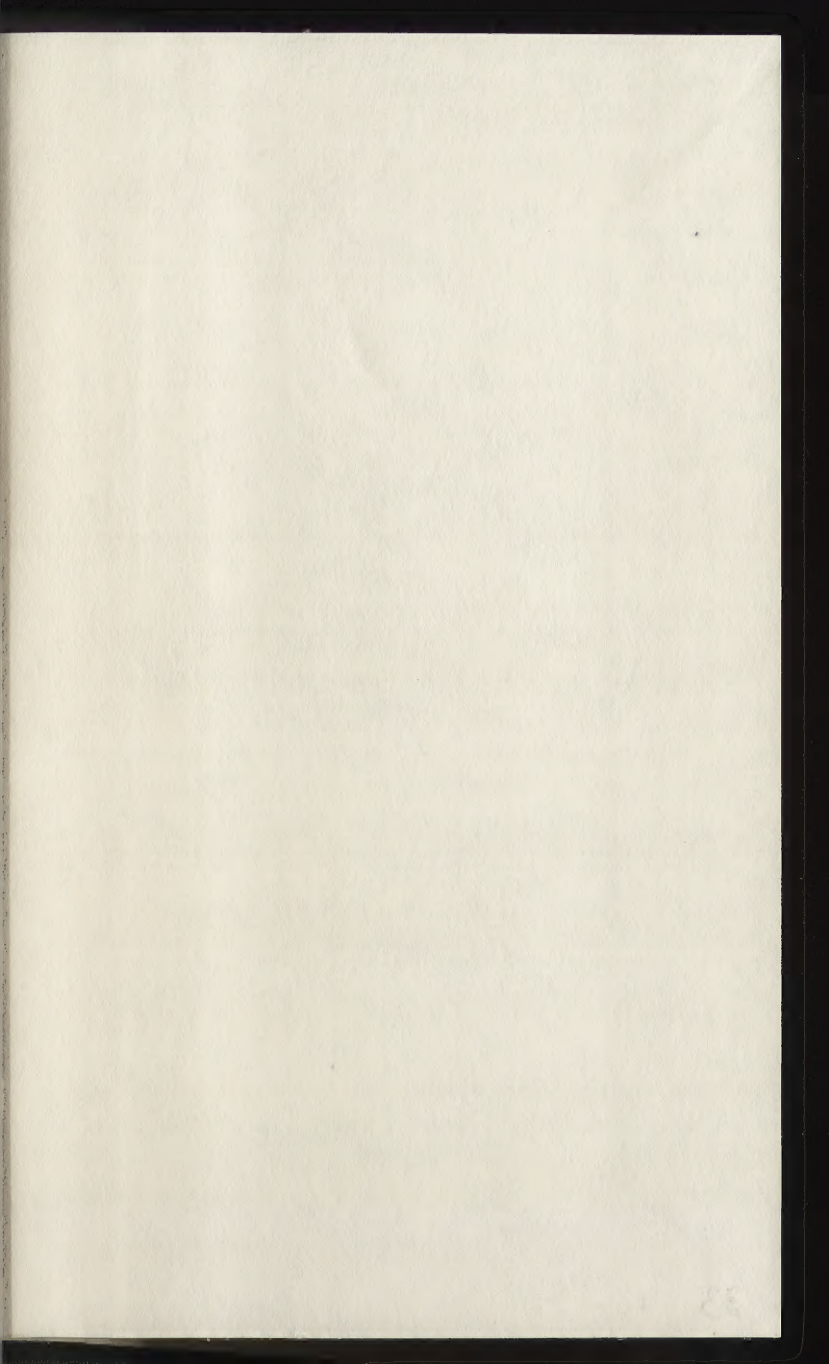
I have frequently had inventors apply to me with plans for supplying coal similar to the above, also by placing iron trays with coal at the bottom of a common grate, but I have never given them any hopes of success, considering most of the contrivances much inferior to that adopted for the stove patented in the year 1813, and mentioned in the commencement of chapter xii.

In the autumn of last year, as a test of my theory on the building of new flues, I was allowed by the kindness of an eminent architect to direct the construction of the chimneys for a lodge, the site for which was considered very unfavourable, being surrounded by high buildings. The lodge was only required to have one story above the ground floor, and some of the buildings immediately contiguous were more than double its intended height. I ordered the chimneys to be built in conformity with the rules laid down for cottage buildings in chapter xi.; they have been used during several months with complete success.

I have at present under my direction the construction of the flues at other buildings, and I anticipate a similar result.

JOHN H. BAKER
PHILADELPHIA

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